IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **DONALD GILBERT CARPENTER** **Art Unit: 2834**

S rial No.: **09/935,936**

Filed: August 23, 2001

For: ***Energy Conversion Technique*** ***Examiner:*** ***Nicolas Ponomarenko***

Appeal Brief

Honorable Commissioner of Patents
Post Office Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith, in triplicate, is applicant's Brief on Appeal in the above-identified matter.

(1) Real Party in Interest:

The applicant named in the caption of this Brief, DONALD GILBERT CARPENTER, is the real party in interest.

(2) Related appeals and Interferences:

None.

(3) *Status of Claims:*

Claims 1 through 8, inclusive, are pending in this application. No claims have been cancelled and pending claims 1 through 8, inclusive, are on appeal.

(4) Status of Amendments Filed Subsequent to Final Rejection:

None.

(5) *Summary of Invention:*

As illustrated in Fig. 3, apparatus for converting kinetic energy into electrical energy has a first moving system 21 and a second moving system 22 (Specification, p. 18, para. 73, lines 21 to 25). The second moving system 22 moves toward and away from the first moving system 21 (Specification, p. 18, para. 73, line 25 to p. 19, line 5).

Objects 46, 47 are ejected electromagnetically by ejectors 38, 40 from respective openings 30, 32 in face 25 of the moving system 21 in the direction of arrow 48 (Specification, p. 19, para. 74, lines 6 to 14). The openings 30, 32, in the face of the first moving system, are aligned with receptor openings 35, 37 (Fig.5) in the second moving system 22 (Specification, p. 17, Para. 74, lines 17 to 21). The objects 46, 47 (Fig. 1) are magnetized (specification, p. 18, para. 76, lines 20 to 25). The openings 35, 37 in the second moving system 22, moreover, house respective receptor conductive coils (only receptor coils 43, 44 are shown in the drawing) for converting the kinetic energy of the individual incoming objects 46, 47 into electrical energy (Specification, p. 17, para. 74, lines 9 to 21).

Among alternative embodiments of the invention, attention is invited to Fig. 6 which shows rods (unnumbered) that extend to both of the moving systems 21, 22. At the same time, the moving systems 21, 22 are each connected, respectively, to drive shafts 51, 52 and 51A, 52A (Specification, p. 23, para.93, lines 15 to 20). Illustrated, moreover, in connection with this *alternative embodiment of the invention is fly-wheel 53, coupled to the drive shafts 51, 51A and a* fly-wheel 54, coupled to the drive shafts 52 and 52A (Specification, p. 23, para. 93, lines 20 to 22). Gear teeth 58 on the fly-wheel 53 and gear teeth 59 on the fly-wheel 54 are provided for electrical or kinetic energy generation (Specification, p. 23, para. 93, line 30 to p. 24, line 2 and p. 24, para. 95, lines 24 and 25).

Turning now to Figs. 8A and 8B, an alternative rod 71 can be used in substitution for the objects 46, 47 illustrated in Fig. 3. Thus, as shown in Fig. 8A, teeth 70 along the length of the rod 71 form a rack that engages (Fig. 8B) pinion gears 84 (Specification, p. 25, para. 99, line 26 to p. 26, line 15). The functions served by the rod 71 are four-fold.

1. Electric motors (not shown in the drawing) drive the pinion gears 84 to eject the rod 71 from its associated moving system;
2. The electric motors are driven during a reverse reciprocation by the action of the rack 70 and pinion gears 84 to change their function and act as dynamos to produce electrical power;
3. The gears 84 can freewheel, if the purpose if to provide release of the rod 71; and
4. To remain motionless, with respect to the associated moving system in that part of the cycle in which the moving systems 21, 22 (Fig. 3) draw away from each other and move toward each other.

(6) Issues:

Does the claimed invention satisfy the "utility" requirement for patentability as expressed in 35 U.S.C. Section 101?

(7) Grouping of Claims:

Each of the eight claims in issue are independently patentable and do not stand or fall together for the reasons advanced in (8), below.

(8) Argument:

Grouping of Claims: Absent application of prior art to the eight claims in issue, applicant is compelled to assert that those claims, because they each recite separate structural features of the invention are individually patentable and do not stand or fall together.

Rejection Under 35 U. S.C. Section 101: To reject all eight claims on appeal, the position has been asserted that the invention is inoperative because it contradicts the principle of conservation of energy (Final Rejection 7/24/03, p. 2, para. 2, lines 5 to 8). Further in this respect, the principle of conservation of energy is restated in the final rejection as a "....statement that the sum total of the energy of the universe is a fixed and unalterable quantity." (Final Rejection, 7/24/03, p. 2, para. 2, lines 10 to 12).

Ordinarily, it is sufficient to say that energy cannot be created or destroyed. In reference to the universe, however, this commonly accepted reference to a principle of conservation of *energy is not correct. The proper "conservation" statement is as a principle of mass/energy* conservation, because mass and energy are interchangeable, energy being equal to the product of mass and the square of the speed of light:

$$E=MC^2$$

Where:

E= energy
M= mass
C= speed of light

Attention in this respect, is invited to Attachment A, appended hereto (McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition, S. P. Parker, Ed., New York, 1994, p. 1217) which establishes the correct conservation definition as one of mass-energy conservation.

Further in support of the correct conservation statement, please note the following passage, quoted from "Theoretical Physics," F. Woodbridge Constant, Addison-Wesley Publishing Company, Inc., Reading, 1958, p. 317 (Attachment B):

> "The basic conservation principle then is the *conservation of mass-energy.*" (Author's italics)

Consequently, because of this interchangeability between mass and energy, it is not correct to state that the sum total of the energy in the universe is a fixed and unalterable quantity. As developed immediately below, moreover, it is even incorrect to revise the foregoing statement to read that the sum total of the mass/energy of the universe is a fixed, unalterable quantity.

For example, please consider carefully, the following quotation from "Principles of Physical Cosmology, P. J. E. Peebles, Princeton University Press, Princeton, 1993, p. 139 (Attachment C):

> However, *since the volume of the universe varies as* $a(t)^3$, *the net radiation* energy in a closed universe decreases as *1/a(t)* as the universe expands. Where does the lost energy go? .. The resolution of this apparent paradox is that while energy conservation is a good local concept, as in equation (6.18), and can be defined more generally in the special case of an isolated system in asymptotically flat space, there is not a general global energy conservation law in general relativity theory.

Consequently, in accordance with information available on current developments in modern physics, the sum total of the energy or even mass/energy of the universe is *not* a fixed, unalterable quantity.

The Board's attention now is invited to Attachment D, which is a copy of a brief, popular science article published in the August, 2003 Edition of the "National Geographic" magazine. This article summarizes in laymen's terms a number of current speculations by informed cosmologists about the size and nature of the universe.

None of these speculations can be construed to even suggest that "..... the sum total of the energy of the universe is a fixed unalterable quantity." At best, the "National Geographic" article underscores the quandary in present cosmological thought about the character of the universe. Clearly, at this passage in our knowledge there is no support at all for any thought or conjecture about the status of the energy (or even mass/energy) composition of the universe.

Accordingly, applicant respectfully submits that the rejection of claims1 through 8 for failure to satisfy the "utility" requirement under 35 U. S. C. Section 101 is based:

1. On a demonstrably inappropriate "conservation" statement. Properly expressed, it is a law of cons rvation of mass/energy and not a law of energy conservation; and

2. The flawed attempt to interpret an inappropriate conservation statement to establish that the sum total of the universe 's energy is a fixed, unalterable quantity, is a position that directly contradicts established cosmological analysis.

In this circumstance, applicant respectfully submits that the final rejection of Claims 1 through 8, inclusive, for lack of utility under 35 U. S. C. Section 101 is based on an incorrectly stated physical principle that is invalid with respect to the universal environment to which it was applied in the final rejection and should be withdrawn. The final rejection then concludes:

1. That the invention contradicts known scientific principles or relies on a previously undiscovered scientific phenomenon; and
2. That the burden shifts to applicant to demonstrate that the claimed invention is operable; or that the basic scientific principles are incorrect, or does not violate basic scientific principles.

The rejection then cites "Manual of Patent Examining Practice "(MPEP) Section 608.03, (Attachment E), to support a requirement to furnish a working model of the invention.

In this connection, the interesting dichotomy that characterizes MPEP Section 608.3 should be considered.

Thus:

Nature of the Objection	Proof of Operativeness
1. Perpetual motion machine	Working model
2. Operativeness questioned	Applicant may choose his way of proving operativeness.

Although a gratuitous reference to perpetual motion machines is made in the final rejection, this remark is not applied either to the application or to the eight claims in issue. Consequently, under the terms of MPEP Section 608.03, there is no ground for requiring applicant to furnish a working model of his invention, and this requirement should be withdrawn.

The final rejection, however, does state that the description in the application is inoperative because it "contradicts known scientific principles". Applicant urges that the foregoing energy conversion analysis clearly establishes not that the conservation law is wrong, but has been misapplied and restated in a manner contrary to current cosmological thinking. In this respect, and in accordance with the specific provisions of MPEP Section 608.03, applicant exercised his right to prove "operativeness" through a simple physical experiment. This experiment was reported in detail in applicant's declaration under 37 C. F. R. Section 132 that was filed in the Patent and Trademark Office on March 7, 2003 (Attachment F) in response to the first substantive Official Action issued in this case.

Kindly note in Applicant's Rule 132 Declaration, the following salient points:

1. Applicant's professional credentials, illustratively; a doctorate in nuclear engineering; Associate Professor of Physics at the United States Air Force Academy for seven years; full professorships in physics and electrical engineering; recipient of the Theodore Von Karman Award for science and engineering; author of twenty-seven scientific books and papers certainly qualify the inventor as a person who knows whereof he writes (cf Rule 132 Declaration, P. 1, lines 3 to p. 2, line 4); and

2. The consequence of the experiment reported in the Rule 132 Declaration is that an extra increment of energy, $2E_{2A}$, is observed and that this energy increment is not to be expected through the usual kinetic energy analysis of two bodies moving toward each oth r (cf Rule 132 Declaration, P. 4, line 11).

The final rejection, however, failed to address, rebut or refute this experimental data.

The explanation for this effect, as experimentally verified in the Rule 132 Declaration, is summarized in the application as filed, p. 2, para. 6, lines 7 to 11,

> An illustrative embodiment of the invention arises from the fact that the kinetic energy of a system of masses in motion relative to each other is different from the kinetic energy of that same system when measured relative to some point outside of the 'moving' system (i. e. a 'stationary' system) that is receding or *advancing relative to the 'moving' system.*

In compliance with MPEP Section 1206, moreover, this rejection under 35 U. S. C. Section 101 does not require applicant to specify particular claim limitations to overcome the final rejection.

In summary, it is respectfully urged that:

1. In the universal terms stated in the final rejection, a law of conservation of energy is incorrect; and
2. To interpret the law of conservation of energy as establishing that the energy of the universe is a fixed, unalterable quantity is in complete disregard of the present state of cosmological thought.

Ergo, the rejection of this application (and claims 1 through 8) as lacking "utility" under 35 U. S. C. Section 101 is in error and should be withdrawn.

Because the application is rejected on the ground that it describes an invention that contradicts known scientific principle, applicant has exercised his right under MPEP Section 608.03 to overcome this rejection by submitting a Rule 132 Declaration. In that Rule 132 Declaration, applicant, a scientist with outstanding professional credentials, produced data that demonstrated the appearance of an increment of energy, $2E_{2A}$, in accordance with the principles of the invention.

As a result, the Board is earnestly solicited to withdraw the working model requirement under MPEP Section 608.03, withdraw the rejection under 35 U. S. C. Section 101; and pass this application to issue.

Respectfully submitted,

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On the c ver: Ph t micrograph f crystals f vitamin B_1.
(Dennis Kunkel, University of Hawaii)

In addition, material has been drawn from the following references: R. E. Huschke, *Glossary of Meteorology*, American Meteorological Society, 1959; *U.S. Air Force Glossary of Standardized Terms*, AF Manual 11-1, vol. 1, 1972; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, 1st ed., National Aeronautics and Space Administration, 1965; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology, White Sands Missile Range, New Mexico*, National Bureau of Standards, AD 467-424; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, 1st ed., Department of Defense, 1967; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission; F. Casey, ed., *Compilation of Terms in Information Sciences Technology*, Federal Council for Science and Technology, 1970; *Glossary of Stinfo Terminology*, Office of Aerospace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Technical, and Imperative Terms*, Bureau of Naval Personnel, 1962; *ADP Glossary*, Department of the Navy, NAVSO P-3097.

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[illegible] not on its chemical composition. Also known as [illegible] mass absorption law. { 'mas əb'sȯrp·shən ¦lȯ }

[illegible] action law [PHYS CHEM] The law that the rate of a [illegible] reaction for a uniform system at constant temperature [illegible] to the concentrations of the substances reacting. [illegible] as Guldberg and Waage law. { 'mas ¦ak·shən ,lȯ }

[illegible] [COMPUT SCI] To process data, primarily to convert [illegible] more useful form or into a form that will simplify [illegible]. [MED] The act of rubbing, kneading, or stroking [illegible] parts of the body with the hand or with an instru[illegible] therapeutic purposes. { mə'säzh }

[illegible]-analyzed ion kinetic energy spectrometry [SPECT] [illegible] of ion kinetic energy spectrometry in which the ionic [illegible] undergo mass analysis followed by energy analysis. [illegible] MIKES. { 'mas ¦an·ə,līzd 'ī,än kə¦ned·ik 'en·ər·jē [illegible] }

[illegible] attraction vertical [GEOPHYS] The vertical which is a [illegible] only of the distribution of mass and is unaffected by [illegible] resulting from the motions of the earth. { 'mas ə¦trak· [illegible] }

[illegible] burning rate [CHEM ENG] The loss in mass per unit [illegible] materials burning under specified conditions. [ORD] [illegible] consumption of propellant charge, usually expressed in [illegible] per second. { 'mas 'bərn·iŋ ,rāt }

[illegible] color See masstone. { ¦mas ¦kəl·ər }

[illegible] communication [COMMUN] Communication which is [illegible] or reaches an appreciable fraction of the population. [illegible] kə,myü·nə'kā·shən }

[illegible] concrete [CIV ENG] Concrete set without structural [illegible]. { 'mas 'kän,krēt }

[illegible] conversion [COMPUT SCI] The transfer of data from [illegible] system to another, in which all the data is con[illegible] in a single operation, rather than in gradual increments. [illegible] kən,vər·zhən }

[illegible] data multiprocessing [COMPUT SCI] The basic con[illegible] of time sharing, with many inquiry stations to a central [illegible] capable of on-line data retrieval. { 'mas ¦dad·ə ,məl· [illegible] }

[illegible] defect [NUC PHYS] The difference between the mass of [illegible] and the sum of the masses of its individual components [illegible] free (unbound) state. { 'mas 'dē,fekt }

[illegible] distance [ENG] The mass carried by a vehicle multi[illegible] the distance it travels. { 'mas ¦dis·təns }

[illegible] divergence [FL MECH] The divergence of the momen[illegible], a measure of the rate of net flux of mass out of a unit [illegible] of a system; in symbols, ∇·ρV, where ρ is the fluid [illegible], V the velocity vector, and ∇ the del operator. { 'mas [illegible] }

[illegible] [FOOD ENG] Sugar industry term for sugar-mo[illegible] mixture prior to the removal of the molasses. [illegible] }

[illegible] conservation [RELAT] The principle that en[illegible] be created or destroyed; however, one form of [illegible] that which a particle has because of its rest mass, equal [illegible] times the square of the speed of light. { 'mas 'en· [illegible] ,vā·shən }

[illegible] relation [RELAT] The relation whereby the to[illegible] content of a body is equal to its inertial mass times [illegible] of the speed of light. { 'mas 'en·ər·jē ri,lā·shən }

[illegible] See quadrupole spectrometer. { 'mäs·ən,fil·tər }

[illegible] [GEOL] A process in which the direct appli[illegible] gravitational body stresses causes earth and rocks to [illegible] carried downslope. Also known as gravity erosion. [illegible] }

[illegible] [ANAT] The masticatory muscle, arising from the [illegible] arch and inserted into the lower jaw. { mə'sēd·ər }

[illegible] See faunal extinction. { 'mas ik'stiŋk·shən }

[illegible] [ATOM PHYS] A formula for the probability [illegible] atom approaching the surface of a metal will [illegible] electrons. { 'masē ,fȯr·myə·lə }

[illegible] [ENG] A pattern of powder flow occurring in hop[illegible] characterized by the powder flowing at every point, [illegible] adjacent to the hopper wall. [FL MECH] The [illegible] fluid in motion which crosses a given area in a unit [illegible] 'flō }

[illegible] [ENG] A bin whose hopper walls are suffi[illegible] and smooth to cause flow of all the solid, without [illegible], whenever any solid is withdrawn. { 'mas ¦flō [illegible]

mass flowmeter [ENG] An instrument that measures the mass of fluid that flows through a pipe, duct, or open channel in a unit time. { 'mas ¦flō,mēd·ər }

mass formula [NUC PHYS] An equation giving the atomic mass of a nuclide as a function of its atomic number and mass number. { 'mas ,fȯr·myə·lə }

mass-haul curve [CIV ENG] A curve showing the quantity of excavation in a cutting which is available for fill. { 'mas ¦hȯl ,kərv }

mass heaving [GEOL] A comprehensive expansion of the ground due to freezing. { 'mas 'hēv·iŋ }

massicot [MINERAL] PbO A yellow, orthorhombic mineral consisting of lead monoxide; found in the western and southern United States. Also known as lead ocher. { 'mas·ə,kät }

Massieu function [THERMO] The negative of the Helmholtz free energy divided by the temperature. { ma'syü ,fəŋk·shən }

massif [GEOL] A massive block of rock within an erogenic belt, generally more rigid than the surrounding rocks, and commonly composed of crystalline basement or younger plutons. { ma'sēf }

massive [GEOL] Of a mineral deposit, having a large concentration of ore in one place. [MINERAL] Of a mineral, lacking an internal structure. [PALEON] Of corallum, composed of closely packed corallites. [PETR] **1.** Of a competent rock, being homogeneous, isotropic, and elastically perfect. **2.** Of a metamorphic rock, having constituents which do not show parallel orientation and are not arranged in layers. **3.** Of igneous rocks, being homogeneous over wide areas and lacking layering, foliation, cleavage, or similar features. { 'mas·iv }

mass law of sound insulation [CIV ENG] The rule stating that sound insulation for a single wall is determined almost wholly by its weight per unit area; doubling the weight of the partition increases the insulation by 5 decibels. { 'mas 'lȯ əv 'sau̇nd ,in·sə,lā·shən }

mass-luminosity relation [ASTROPHYS] A relation between stellar magnitudes and mass of the stars; when the absolute magnitudes of stars are plotted versus the logarithms of their masses, the points fall closely along a smooth curve. { 'mas ,lü·mə'näs·əd·ē ri,lā·shən }

mass-memory unit [COMPUT SCI] Drum or disk memory that provides rapid access bulk storage for messages that are awaiting availability of outgoing channels. { 'mas 'mem·rē ,yü·nət }

mass movement [GEOL] Movement of a portion of the land surface as a unit. { 'mas 'müv·mənt }

mass number [NUC PHYS] The sum of the numbers of protons and neutrons in the nucleus of an atom or nuclide. Also known as nuclear number; nucleon number. { 'mas ,nəm·bər }

mass operator [QUANT MECH] An operator which is added to the Lagrangian in a quantized field theory in order to eliminate certain infinite quantities, and whose sum with the mechanical mass gives the observed mass. { 'mas 'äp·ə,rād·ər }

mass ratio [AERO ENG] The ratio of the mass of the propellant charge of the rocket to the total mass of the rocket when charged with the propellant. { 'mas 'rā·shō }

mass reactance See acoustic mass reactance. { 'mas rē'ak·təns }

mass reflex [PHYSIO] A spread of reflexes suggesting lack of control by higher cortical centers; seen in normal newborns, in persons under the influence of drugs or in severe emotional states, and in encephalopathy or high spinal cord transections. { 'mas 'rē,fleks }

mass renormalization [QUANT MECH] The mathematical operation of adding the mass which a particle possesses because of its self interaction, to its mechanical mass in order to obtain its measured mass. { 'mas rē,nȯr·mə·lə'zā·shən }

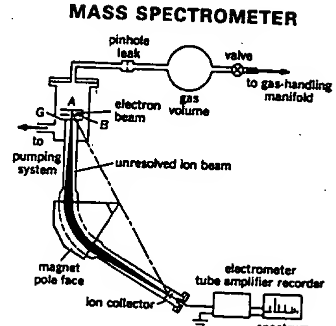
mass resistivity [ELEC] The product of the electrical resistance of a conductor and its mass, divided by the square of its length; the product of the electrical resistivity and the density. { 'mas ,rē,zis'tiv·əd·ē }

mass shift [NUC PHYS] The portion of the isotope shift which results from the difference between the nuclear masses of different isotopes. { 'mas 'shift }

mass spectrograph [ENG] A mass spectroscope in which the ions fall on a photographic plate which after development shows the distribution of particle masses. { 'mas 'spek·trə,graf }

mass spectrometer [ENG] A mass spectroscope in which a slit moves across the paths of particles with various masses, and

MASS SPECTROMETER



Schematic diagram of mass spectrometer tube. Electric field caused by potential difference of several volts between plates A and B draws ions through slit in B. Ions are further accelerated by potential difference of hundreds or thousands of volts between B and G.

THEORETICAL PHYSICS

Thermodynamics, Electromagnetism, Waves, and Particles

by

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again tells us that no material object can attain a speed equal to or greater than the speed of light.

Since objects in everyday life do not have speeds at all close to that of light, their variation of mass with velocity is not measurable. However, in the case of such small particles as the electron, proton, deuteron, etc., it has been possible to verify Eq. (14–27) experimentally. A beta particle from a radioactive source, or an electron accelerated to a high energy in a betatron, may have a speed sufficient for its apparent mass to be several times its rest mass. For the heavier proton to show a mass increase of the same proportion as that for an electron, the energy of the proton must be 1840 times as great; nevertheless our powerful proton accelerators, such as the synchrotron and cosmotron, reach energies well past the threshold beyond which mass variation must be taken into account.

14–11 Einstein's mass-energy relationship. We have seen that relativity requires that Newton's law of motion must be expressed as in Eq. (14–24) and that at the same time we must take m to vary in accord with Eq. (14–27). With m variable, Eq. (14–24) may be written as

$$\mathbf{F} = \frac{d}{dt}(m\mathbf{v}) = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt} = m\mathbf{a} + \mathbf{v}\frac{dm}{dt}. \tag{14–28}$$

We see that the equation $\mathbf{F} = m\mathbf{a}$ does not hold at high speeds if we take $m = m_0$, nor is it valid in general if we take m to be the apparent mass. In fact, if $\mathbf{v}$ and $\mathbf{a}$ are in the *same* direction, we find (see problem 6 at end of this chapter) that

$$\mathbf{F} = \frac{m_0}{(1 - v^2/c^2)^{3/2}}\,\mathbf{a}, \tag{14–29}$$

where $m_0/(1 - v^2/c^2)^{3/2}$ is called the *longitudinal inertial mass*. Inertial mass is defined as the ratio F/a. On the other hand, if $\mathbf{F}$ is perpendicular to $\mathbf{v}$, the inertial mass is found to be the same as the apparent mass given by Eq. (14–27). NOTE

From the conservation of energy principle, we take the kinetic energy of a moving body to be the work done by the force that accelerates the body from rest. If we retain the definition of work as force times distance, and assume linear motion, we have

$$\text{K.E.} = \int_{v=0}^{v=v} F\,ds = \int_0^v \frac{d}{dt}(mv)\,ds = \int_0^v \frac{d}{dt}(mv)\frac{ds}{dt}\,dt$$

$$= \int_0^v v\frac{d}{dt}(mv)\,dt = \int_0^v v\,d(mv).$$

Substituting for m from Eq. (14–27) and integrating, we get

$$\begin{aligned}
\text{K.E.} &= \int_{v=0}^{v=v} v\, d\left(\frac{m_0 v}{\sqrt{1 - v^2/c^2}}\right) \\
&= m_0 \int_0^v \left[\frac{1}{\sqrt{1 - v^2/c^2}} + \frac{v^2}{c^2(1 - v^2/c^2)^{3/2}}\right] v\, dv \\
&= m_0 \int_0^v \frac{v\, dv}{(1 - v^2/c^2)^{3/2}} = m_0 c^2 \left|\frac{1}{(1 - v^2/c^2)^{1/2}}\right|_0^v \\
&= m_0 c^2 \left(\frac{1}{\sqrt{1 - v^2/c^2}} - 1\right). \qquad (14\text{–}30)
\end{aligned}$$

This is the *relativistic expression for kinetic energy.* If the first term is expanded by the binomial theorem, we find that

$$\text{K.E.} = m_0 c^2 \left(1 + \frac{1}{2}\frac{v^2}{c^2} + \frac{3}{8}\frac{v^4}{c^4} + \cdots - 1\right),$$

which reduces to the familiar $\frac{1}{2} m_0 v^2$ of Newtonian dynamics when $v \ll c$.

Equation (14–30) may be rewritten as

$$\text{K.E.} = mc^2 - m_0 c^2 = (m - m_0)c^2. \qquad (14\text{–}31)$$

Thus the kinetic energy of a moving body equals its gain in mass times c^2. We may also say that the apparent mass of a body increases linearly with its kinetic energy, so that an increase in mass is an indication and measure of the gain in kinetic energy. It is also found* that an increase in the potential energy of a system of particles is accompanied by a similar increase in mass equal to the gain in energy divided by c^2. Therefore we may say, in general, that *the gain (or loss) in the energy of a system is equal to the gain (or loss) in its apparent mass multiplied by* c^2.

We may go one step further and interpret the term $m_0 c^2$ in Eq. (14–31) as the *rest energy* of a body whose rest mass is m_0. This rest energy may

*See Richtmeyer, Kennard, and Lauritsen, *Introduction to Modern Physics*, 5th ed., pp. 69–70.

be regarded as a form of internal energy inherent in the nature of the particles out of which matter is composed. Then

$$\begin{aligned}
mc^2 &= \text{rest energy} + \text{kinetic energy} \\
&= \text{total energy}.
\end{aligned}$$

If here we let E stand for the total energy, we arrive at Einstein's famous *principle of the equivalence of mass and energy.*

$$E = mc^2. \qquad (14\text{–}32)$$

The value of any theory is measured by its success in predicting new results. In this respect Einstein's theory has been outstanding. In nuclear physics the equivalence of mass and energy has been put to the test repeatedly and it has always been confirmed. With the ability to measure the masses of atomic particles to a high degree of accuracy, nuclear physicists have been able to predict the energy changes accompanying nuclear and particle transmutations, and they have also been able to verify their predictions experimentally. The whole subject of nuclear energy (popularly called "atomic energy") illustrates the usefulness of the above principle. The energy exchanges involved in chemical reactions must also be accompanied by corresponding mass changes, but in this relatively low-energy field the mass changes are too small to be detected experimentally.

While chemical reactions and most nuclear ones involve a rearrangement of atomic or subatomic particles, the electron-positron and the proton-antiproton reactions are exceptions. In the latter two cases, physicists apply the mass-energy equivalence principle in various ways. Some say that when an electron and positron are annihilated, their rest mass is converted into energy in the form of radiation called gamma rays; however, we shall see in the next chapter that gamma rays may be considered to be photons or light particles, which, because of their energy, carry with them the momental mass originally associated with the electron and positron. It would seem preferable to regard energy as a property of mass, or mass as a property of energy, the two being inseparable. The basic conservation principle then is the *conservation of mass-energy.*

EXAMPLE. An electron and positron which are practically at rest come together and annihilate each other, producing two photons of equal energy. Find the energy and equivalent mass of each photon.

Solution. The rest mass m_0 of an electron is 9.1×10^{-31} kg. This is equivalent (in the mks system) to the energy

P. J. E. PEEBLES

Principles of Physical Cosmology

Princeton Series in Physics

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Principles of Physical Cosmology

P. J. E. PEEBLES

During the last twenty years, dramatic improvements in methods of observing astrophysical phenomena from the ground and in space have added to our knowledge of what the universe is like now and what it was like in the past, going back to the hot big bang. In this overview of today's physical cosmology, P.J.E. Peebles shows how observation has combined with theoretical elements to establish the subject as a mature science, while he also discusses the most notable recent attempts to understand the origin and structure of the universe. A successor to Peebles's classic volume *Physical Cosmology* (Princeton, 1971), the book is a comprehensive overview addressed not only to students but also to scientists active in fields outside cosmology.

The first part of the work presents the elements of physical cosmology, including the history of the discovery of the expanding universe. The second part, on the cosmological tests that measure the geometry of spacetime, discusses general relativity theory as the basis for the tests, and then surveys the broad variety of ways the tests can be applied with the new generations of telescopes and detectors. The third part deals with the origin of galaxies

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and the large-scale structure of the universe, and reviews ideas about how the evolution of the universe might be traced back to very early epochs when structure originated. Each chapter begins with an introduction that can be understood with no special knowledge beyond undergraduate physics, and then progresses to more specialized topics.

P.J.E. Peebles is Albert Einstein Professor of Science at Princeton University. He is a Fellow of the American Academy of Arts and Sciences and the Royal Society.

Princeton Series in Physics
Philip W. Anderson, Arthur S. Wightman, and Sam B. Treiman, Editors

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The Large-Scale Structure of the Universe

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The second step follows from the change of variables $x = \hbar\omega/kT$, with the dimensionless integral

$$I_- = \int_0^\infty \frac{x^3\,dx}{e^x - 1} = \frac{\pi^4}{15}. \tag{6.15}$$

Equation (6.14) is the Stefan-Boltzmann law. We will use the standard symbol, a, for Stefan's constant when it is easily distinguished from the expansion parameter.

The heat capacity of the CBR at fixed volume is $4aT^3$. If the matter consists of atomic hydrogen, the ratio of its heat capacity to that of the CBR is

$$\frac{1.5 n_B k}{4aT^3} = 4 \times 10^{-9}\Omega h^2, \tag{6.16}$$

where n_B is the mean number density of hydrogen atoms (eq. [5.68]). This ratio is independent of redshift. Its small value explains why the CBR might be expected to have a closely thermal spectrum: at high redshifts, where the interaction between matter and radiation is appreciable, the matter relaxes to the radiation temperature, because the radiation has by far the higher heat capacity, and at thermal equilibrium the radiation spectrum remains thermal no matter how strong the interaction.

The ratio of the mean mass density in matter (eq. [5.67]) to the mass density in the CBR at the temperature in equation (6.1) is

$$\frac{\rho_b c^2}{aT^4} = 4.0 \times 10^4\,\Omega h^2 (1+z)^{-1}. \tag{6.17}$$

The redshift dependence follows because the energy density in the CBR varies as $(1+z)^4$ (because $T \propto 1/a(t)$ in eq. [6.4]), one power faster than for the nonrelativistic matter. With the lower bound on the mass density parameter Ω in equation (5.150), we see that at the present epoch the energy density in the radiation is a small fraction of the total. It follows that when the redshift is not too large the energy available from annihilation of mass by nuclear burning (or perhaps by the more efficient process of accretion by black holes) is sufficient to produce an appreciable perturbation to the radiation temperature. Whether this can have happend depends on whether there is a way to transfer the energy to the CBR while keeping the spectrum close to thermal. Some details on how this might happen are discussed in the next section and in section 24.

Two features in the standard interpretation of the CBR tend to be confusing. We have already noted in section 1 that the name for the standard model, the hot big bang, is misleading, for a bang suggests a localized explosion. In the standard picture the source of the CBR is not localized; the radiation is uniformly and isotropically distributed throughout the space we can observe. This agrees with

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of photons is decreasing with time as
the universe—there is nowhere else to
increasing as $a(t)^3$.

The second confusing point is the na
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$$= -4$$

The solution is

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Discovery

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the fact that the radiation is equally bright in all directions. The number density of photons is decreasing with time as $a(t)^{-3}$, not because photons are leaving the universe—there is nowhere else to go—but because the volume of space is increasing as $a(t)^3$.

The second confusing point is the nature of energy balance in the CBR. Since the energy density in blackbody radiation varies as the fourth power of the temperature, the expansion of the universe causes the radiation energy density to evolve as $\rho_\gamma \propto T^4 \propto a(t)^{-4}$. As indicated in equation (6.17), this is faster by one power of the expansion parameter than for the mass density in a gas of nonrelativistic particles such as baryons (eq. [5.19]). The number density of photons varies as $a(t)^{-3}$, as for baryons, but there is an extra factor of $1/a(t)$ for the redshift of the mean energy per photon. Another way to get the cooling law is to recall that the pressure of the radiation is $p_\gamma = \rho_\gamma/3$. With this equation of state, the local energy conservation equation (5.16) is

$$\begin{aligned}\frac{d\rho_\gamma}{dt} &= -3(\rho_\gamma + p_\gamma)\frac{\dot a}{a}\\ &= -4\rho_\gamma\frac{\dot a}{a}\,.\end{aligned} \qquad (6.18)$$

The solution is

$$\rho_\gamma \propto a(t)^{-4}\,, \qquad (6.19)$$

consistent with the Stefan-Boltzmann law (6.14) and the redshift law (6.4) for the radiation temperature. We see that the faster decrease of ρ_γ compared to the mass density of a nonrelativistic gas is the result of the pressure work done by the expanding radiation. However, since the volume of the universe varies as $a(t)^3$, the net radiation energy in a closed universe decreases as $1/a(t)$ as the universe expands. Where does the lost energy go? Since there is no pressure gradient in the homogeneously distributed radiation, the pressure does not act to accelerate the expansion of the universe. (The active gravitational mass due to the pressure has the opposite effect, slowing the rate of expansion, as indicated in eq. [5.15]). The resolution of this apparent paradox is that while energy conservation is a good local concept, as in equation (6.18), and can be defined more generally in the special case of an isolated system in asymptotically flat space, there is not a general global energy conservation law in general relativity theory.

Discovery

The history of the discovery and interpretation of the CBR is worth considering as an example of the curious paths progress in science can take.

Lemaître was the first to speculate on the physics and possible observable remnants of the very early stages of expansion of the universe. He imagined

Who Knew?

COSMOLOGY

The Multiverse

The universe as we know it just got more complicated

The universe is bigger than we think. This seems to be a cosmic truth. Times change, theories evolve, astronomers see new things in their telescopes—and the universe always turns out to be vaster and more mind-boggling than anyone suspected. The most dazzling new theory holds that our universe isn't just big, it's one of many. It's like a bubble in a huge vat of beer, and every other bubble is another universe. (We like this image for some reason.)

Our concept of the universe used to be tidier. Ancient Egyptians thought the sky was held up by mountains at the corners of the Earth, and the stars were not so far away. But in the 17th century the telescope shattered that notion. Through the lens, the stars were countless, and space had depth. Stars were suns, rendered faint only by great distance. Then, in 1923, Edwin Hubble proved that mysterious, wispy things called nebulae are actually galaxies, or "island universes," outside our own.

New telescopes have since revealed ever more galaxies, and we've grown accustomed to living in Carl Sagan's cosmos, with *billions and billions* of galaxies, each utterly lousy with stars. But Sagan may have been underestimating.

A satellite called the Wilkinson Microwave Anisotropy Probe recently captured a glimpse of the residual radiation from the young universe, when there were no galaxies, only perturbations in a seething, expanding cosmos. The data give a precise age to the universe: 13.7 billion years, plus or minus 200 million years. Perhaps more significantly, the data support the idea of cosmic inflation, a variant of the big bang. The inflationary theory states that very early in the expansion the cosmos suddenly inflated, becoming unimaginably vast in a fraction of a second.

If inflation is correct, the universe really is more than a million trillion trillion trillion times larger than the already enormous visible cosmos. It's practically infinite in scale. You have to speak like a child to convey the idea—it's basically a gazillion times larger than we thought. And there's more: One variation of the inflation theory suggests that our universe is a calm bubble, a kind of "no inflation zone" within an infinitely large, chaotic, eternally inflating "multiverse," and that this multiverse contains countless bubble universes, some of which almost surely contain intelligent observers trying to make sense of their own crazy cosmos.

The problem is, a multiverse is a hard theory to prove. "Is this science? Not yet," warns cosmologist Michael Turner of the University of Chicago. "We can't test it."

But here's the most alarming part about living in a multiverse. If the cosmos is more or less infinite in scale, then statistical probabilities dictate that somewhere there's a planet identical to Earth, containing creatures identical to us, leading identical lives.

We don't buy it. Could there really be another world where Adam Sandler is a movie star?

—*Joel Achenbach*
WASHINGTON POST STAFF WRITER

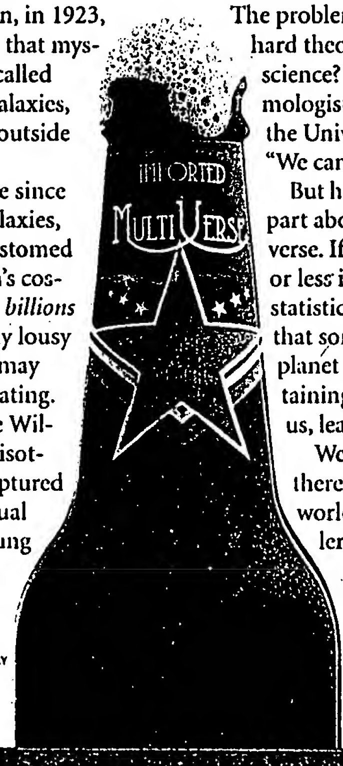

PHOTO ILLUSTRATION BY CARY WOLINSKY

IT MATTERS

How far apart are those two planets? Scientists measure length in meters. Kilometers and centimeters are just multiples and fractions (respectively) of the basic unit. But exactly how long *is* a meter? Since 1983 the International Bureau of Weights and Measures in Sèvres, France (keepers by treaty of the world's standard units of measurement), has decreed that a meter is precisely the distance light travels through a vacuum in 1/299,792,458 of a second. (How do you measure a hundred-millionth of a second? Don't ask.) That degree of precision matters. If astronomers measured a meter the way most Americans do ("Y'know, about a yard") imprecision would multiply prodigiously. Just between Earth and Mars you'd get a measurement mistake four million miles long.

—*Lynne Warren*

WEBSITE EXCLUSIVE

Learn more about the shape of the cosmos and find links to Joel Achenbach's work at nationalgeographic.com/ngm/resources/0308.

and the Notice of Allowability was mailed prior to the receipt of the substitute drawings, the technical support staff should forward the substitute drawings to the Publishing Division. Submission to the examiner is not necessary unless an amendment accompanies the drawings which changes the specification, such as where the description of figures is added or canceled.

BORROWING FILES FROM PUBLISHING DIVISION

Allowed files requiring drawing corrections are sent to the Publishing Division. At times, examiners have a need to borrow these applications. When borrowing applications, examining corps personnel must submit a request to the Office of Patent Publications Customer Service Center.

37 CFR 1.312 AMENDMENTS

In handling 37 CFR 1.312 amendments, the examining corps should process drawings canceled in the normal manner. If there are corrections to the drawing, approval, if appropriate, is indicated by the examiner on form PTOL-271 in conjunction with form paragraph 6.48; the paragraph sets the appropriate period for effecting the approved drawing change.

¶ 6.48 Drawing Changes in 37 CFR 1.312 Amendment

Applicant is hereby given ONE MONTH from the mailing date of this letter or until the expiration of the period set in the "Notice of Allowance" (PTOL-85) or "Notice of Allowability" (PTOL-37 or PTO-37), whichever is longer, to file corrected drawings.

Examiner Note:

Use with the 37 CFR 1.312 amendment notice where there is a drawing correction proposal or request.

608.03 Models, Exhibits, Specimens

35 U.S.C. 114. Models, specimens.

The Director may require the applicant to furnish a model of convenient size to exhibit advantageously the several parts of his invention.

When the invention relates to a composition of matter, the Director may require the applicant to furnish specimens or ingredients for the purpose of inspection or experiment.

37 CFR 1.91. Models or exhibits not generally admitted as part of application or patent.

(a) A model or exhibit will not be admitted as part of the record of an application unless it:

(1) Substantially conforms to the requirements of § 1.52 or § 1.84;

(2) Is specifically required by the Office; or

(3) Is filed with a petition under this section including:

(i) The fee set forth in § 1.17(h); and

(ii) An explanation of why entry of the model or exhibit in the file record is necessary to demonstrate patentability.

(b) Notwithstanding the provisions of paragraph (a) of this section, a model, working model, or other physical exhibit may be required by the Office if deemed necessary for any purpose in examination of the application.

Models or exhibits are generally not admitted as part of an application or patent unless the requirements of 37 CFR 1.91 are satisfied.

With the exception of cases involving perpetual motion, a model is not ordinarily required by the Office to demonstrate the operativeness of a device. If operativeness of a device is questioned, the applicant must establish it to the satisfaction of the examiner, but he or she may choose his or her own way of so doing.

A physical exhibit, not to be part of the application, is generally not refused except when bulky or dangerous. Such exhibit, if left with the examiner, may be disposed of at the discretion of the Office.

37 CFR 1.93. Specimens.

When the invention relates to a composition of matter, the applicant may be required to furnish specimens of the composition, or of its ingredients or intermediates, for the purpose f inspection or experiment.

See MPEP Chapter 2400 regarding treatment of biotechnology deposits.

608.03(a) Handling of Models, Exhibits, and Specimens

All models and exhibits received in the U.S. Patent and Trademark Office should be taken to the Technology Center (TC) assigned the related application for examination. The receipt of all models and exhibits which are to be entered into the application file record must be properly recorded on the "Contents" portion of the application file wrapper.

A label indicating the application number, filing date, and attorney's name and address should be attached to the model or exhibit so that it is clearly identified and easily returned after prosecution of the application is closed, if return is requested and the model or exhibit is deemed not necessary for the examination of the application. See 37 CFR 1.94.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **DONALD GILBERT CARPENTER** **Art Unit: 2834**

Serial No.: **09/935,936**

Filed: **August 23, 2001**

For: Energy Conversion Technique **Examiner: Nicolas Ponomarenko**

Declaration Under 37 C.F.R. ¶ 132

I, the undersigned Dr. Donald G. Carpenter, residing at 3010 River Mist Grove, Colorado Springs, CO 80922-5201 declare as follows:

I am a retired Air Force Colonel, pilot and Commander who has strong credentials and success in both academic and industrial careers.

Academically, I have a Ph.D. and a master's degree in nuclear engineering, plus bachelor degrees in physics, electrical engineering, and electronic engineering technology. I taught physics for seven years at the United States Air Force Academy, holding during that time an Associate Professorship. I created the space physics course at the Air Force Academy, editing and writing much of the 700+ page textbook for that course. I retired as a full Professor of physics (Chapman College) and full Professor of electrical engineering (Colorado Technical University), and Dean of electrical engineering and computer engineering (Colorado Technical University).

My published works include 27 scientific papers and books. Other scientific efforts include numerous published letters, abstracts and invited talks. I was, while on active duty in the Air Force, a recipient of the Theodore von Karman Award (for science and engineering) for dramatic improvement in the accuracy of the SPACETRACK System for tracking Earth-orbiting satellites.

Also, while on active Air Force duty, I received the Legion of Merit for management of the 16th Surveillance Squadron (a SPACETRACK radar organization in the Aleutian Islands). I subsequently commanded a worldwide AF operations organization. My last active duty position before retiring from the Air Force was Chief of Space Surveillance. I was, moreover, in charge of systems engineering (electronic) for Contel's contract to provide ground/space telecommunications at Falcon Air Base (Space Command); and was a principal engineer in enabling Falcon to function well.

Following my retirement from active Air Force duty I worked for COLSA as a telecommunications consultant to the Royal Saudi Air Defense Forces.

Among my further technical and scientific achievements, I was the first scientist to warn and prove theoretically (***Journal of Geophysics***) that nuclear reactors in orbit about Earth would

significantly increase the geomagnetically-trapped corpuscular radiation; subsequent Japanese experience with Russian Earth-orbiting reactors proved my analysis to be correct.

I also have held various other positions such as Senior Research Fellow for the International Society for Scientific Enquiry (ISPE).

Experimental Apparatus

The Experimental Apparatus equipment described herein is of minimum accuracy and precision, difficult to use, but quite inexpensive (see Figure 1). It is similar to that of a double pendulum. A wooden bar is supported at each end. Hanging by stranded picture wires from the wooden bar are two identical metal hex-head screws ([5/8]-1 1 4) so that, at the bottom of their respective swings, the heads of the screws engage endwise (and compress) a spring mounted between them. Each screw is suspended by two stranded wires, and each of those wires has one end attached to its own small hook screwed into one side of the wooden bar with the other end of the wire similarly attached to the other side of the wooden bar.

The screws are operated by swinging each of them back from the other, gaining potential energy as they necessarily rise to a pre-selected 'standard location'. They are released, allowing the potential energy to convert to kinetic energy as they return to their former lower positions and deposit the kinetic energy into the spring. The spring is made of 15 turns of number 19 steel wire coiled 33 millimeters long and of 11 millimeters outside diameter. Each screw head is larger than the diameter of the spring.

As shown in Figures 2 and 3, three paper cylinders are needed, with the first nested inside the second which is nested inside the third, so that each of the two nested cylinders slide relatively freely within the next larger cylinder. Their summed length needs to total greater than the length of the spring, each cylinder itself being less than 50% of the length of the spring (Figure 1). They are positioned in partially-nested fashion within the spring (Figure 3) so that their combined partially-nested length is the same as that of the 33 millimeter spring. Together, the spring and its enclosed partially-nested paper cylinders form an energy sensor. It is necessary that the paper cylinders have a small but non-zero amount of friction with respect to each other. Too little friction and the impact of the screw will cause the paper cylinders to over-respond; too much friction and the paper cylinders will not respond adequately. "Super Glue," a trademarked product is suitable for making the paper cylinders, but care must be taken to insure that the friction among the cylinders is adequate for the purpose of the experiment.

Experiment and Resultant Data

The experiment is tried three different times under each of three different conditions. The first condition is that the spring is suspended on thread below the wooden bar such that the screw heads will engage and compress it at their maximum speed (bottom of their paths). Before each trial, the partially-nested paper cylinders are placed within the spring so that one end of the largest cylinder is at one end of the spring and the contiguous opposite end of the smallest cylinder is at the other end of the spring. The length of the spring is recorded (x_0). Each screw is drawn back to its standard location, and they are released simultaneously. As the spring is struck on both ends approximately simultaneously and compressed, the total contiguous length of the

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partially-nested paper cylinders is reduced as shown in Figure 4. The new total length of the paper cylinders is measured after the system has settled down, and that length is recorded (x_1). The difference between it and the recorded, uncompressed spring length yields a measure (x_0-x_1=Δx_1) of the amount the spring was compressed. After this has been done three times, the results are averaged, and the average value (Δx_{1A}) is recorded to a precision of one millimeter for this first condition.

The second condition, illustrated in Figure 5, is that the spring is bonded (with Super Glue) by one end to the head of Screw 1 so that the free end of the spring rests loosely against the head of Screw 2. One end of the partially-nested cylinders is against the Screw 1 end of the spring while the other end of the partially-nested cylinders is at the other end of the now-cantilevered spring. Screw 1 is fixed in position so that it will not move when the spring is struck by the head of Screw 2. Screw 2 is withdrawn to its standard position and released. Again the resultant total length of the nested cylinders (x_2) is measured, and the magnitude of the spring compression found (x_0-x_2=Δx_2). After this has been done three times and the results averaged, the average value (Δx_{2A}) is recorded to a precision of one millimeter for this second condition.

The third condition, shown in Figure 6, is similar to the second condition in that one end of the spring is still bonded to Screw 1, and the free end of the spring rests loosely against the head of Screw 2. One end of the partially-nested cylinders remains at the other contiguous end of the cantilevered spring. Screw 1 and Screw 2 are each withdrawn to their standard locations and released simultaneously. Again the total length of the nested cylinders (x_2) is measured, and the magnitude of the spring compressed found (x_0-x_3=Δx_3). After this has been done three times and the results averaged, the average value (Δx_{3A}) is recorded to a precision of one millimeter for this third condition.

Theory

The spring and nested cylinders form an energy sensing device. When, as shown in Figure 5, a single moving screw and a single stationary screw compress the spring, the magnitude of the Force (**F**) exerted on the spring at each instant is **F**=k(**Δx**), where k is the spring constant and (**Δx**) is the amount of compression. Force through differential distance (**d[Δx]**) is the differential Energy (dE) or work, which in integrated form for the second condition is $\mathbf{E_{2A}}$= $(\Delta x_{2A})^2(k/2)$. The value of $\mathbf{E_{2A}}$ is the potential energy of a suspended single Screw before release from its standard location, and that same Screw's kinetic energy as it initially encounters the near end of the spring.

The value of $\mathbf{E_{1A}}$ is the average of the sum of the potential energies of the two Screws ($\mathbf{E_{1A}}$=2$\mathbf{E_{2A}}$) that is deposited into the spring. Note that this conforms to the law of conservation of energy, and should be equal to approximately two times the potential energy of one screw.

The value of $\mathbf{E_{3A}}$ (illustrated in Figure 6) is a bit more of a problem for both minor and major reasons. The spring and nested paper cylinders are now part of Screw 1. The law of conservation of energy says that, when viewed from the position of the experimenter, the energy measured must equal approximately the sum of the potential energies ($\mathbf{E_{1A}}$) of the two screws at their standard locations, which is about two times the potential energy ($\mathbf{E_{2A}}$) of one screw at its

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standard position. The word approximately is used because the mass of Screw 1 now includes the mass of the spring and nested paper cylinders with glue. This, though, is a minor problem because the combined mass of the spring, nested paper cylinders, and dried glue is a very small fraction of the mass of a screw. The increase in energy expended is, thus, a minor fraction of the kinetic energy of one screw alone.

The major problem is that the energy measuring device is now part of Screw 1's system. It does not 'see' itself as moving but does see the Screw 2 system approaching a speed 2v. This view is part of the concept first enunciated by Jules Henri Poincaré*: the laws of physics are the same in every frame of reference that is moving linearly with respect to each other. This means that $E_{3A}=4E_{2A}=2E_{1A}$ instead of $E_{3A}=2E_{2A}=E_{1A}$, as anticipated by the law of conservation of energy. Thus, because $E_{3A}-2E_{2A}=2E_{2A}$, an extra $2E_{2A}$ becomes available that comes from some source, the nature of which is not at all clear at this writing.

Results

The experimental results are shown in Table 1. Due to the lack of precision with these present experimental components, all numbers are rounded to the nearest millimeter, or to the nearest whole number in the case of fractions.

TABLE 1: Experimental Results

Condition	*Spring Length (mm)* Original	Compressed	Δx_{CA}	$(\Delta x_{CA})^2$	$E_{CA}=(\Delta x_{CA})^2(k/2)$	E_{CA}/E_{2A}
C=1 (Cons. Energy)	33	26	7	49	49(k/2)	2
C=2 Cantilevered, One Screw, Immobilized	33	28	5	25	25(k/2)	1
C=3 Cantilevered, Both Screws Moving	33	23	10	100	100(k/2)	4

Conclusions

With respect to condition 1, the laws of conservation of momentum and conservation of energy both pertain. Both conservation of momentum and conservation of energy also pertain in condition 2. For condition 3, the law of conservation of momentum pertains and the law of conservation of energy is believed to pertain, the 'extra' energy ($2E_{2A}$) that appears in condition 3 coming from some source not previously recognized in such cases.

It must be emphasized that the device described in the instant patent application is no more a 'perpetual motion' machine than is a hydroelectric transformer. We do not know for

certain at this time from where the extra energy comes for this simple experiment just as we also do not know why a wire moving at a right angle (relative to a magnetic field) through a magnetic field produces an electrical potential between the two ends of the wire. Thus, we do not know why a hydroelectric generator works.

Turning to the claimed invention, it matters not from whence this energy actually comes, it only matters that the claimed apparatus is a device that accesses this energy form without regard to the source of the energy.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date MARCH 4, 2003

Donald G. Carpenter

Reference

* H. Poincaré, 'L'etat Actuel et L'avenir de la Physique Mathematique' (The actual state and the path of mathematical physics) is the name of a lecture given at the St. Louis Conference, USA, 1904 September 24 (This information from the notes of Walter van der Kamp [died: 1998 January 26] was courteously supplied by C. van der Kamp 1998 August 25, Semi-private Communication).

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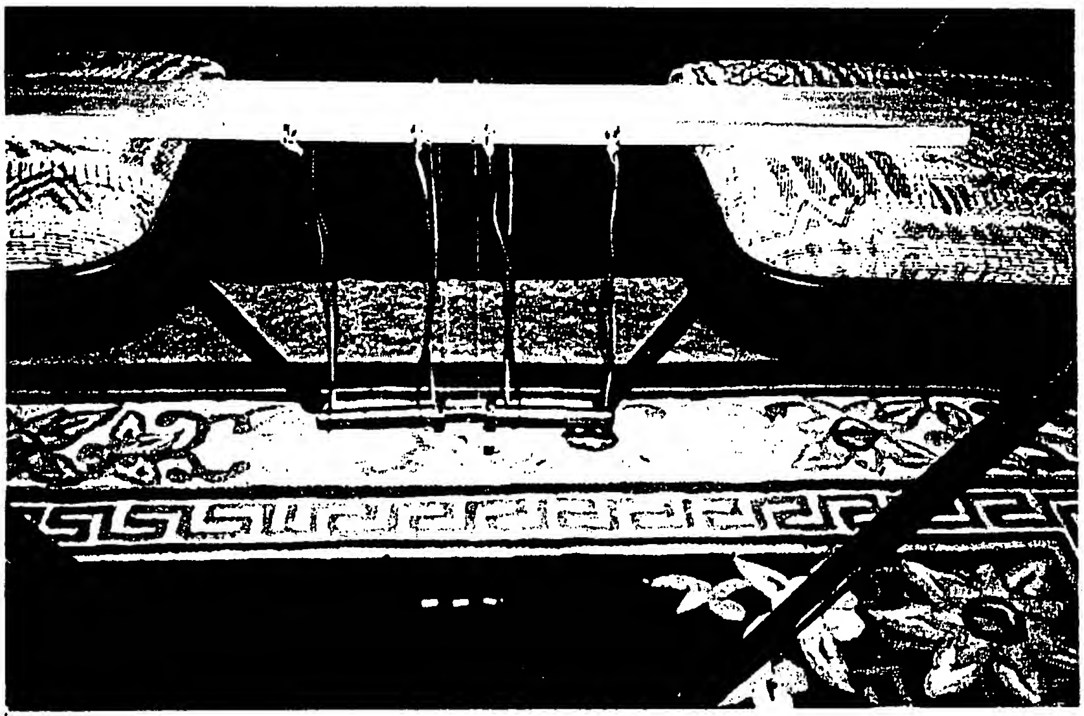

Figure 1

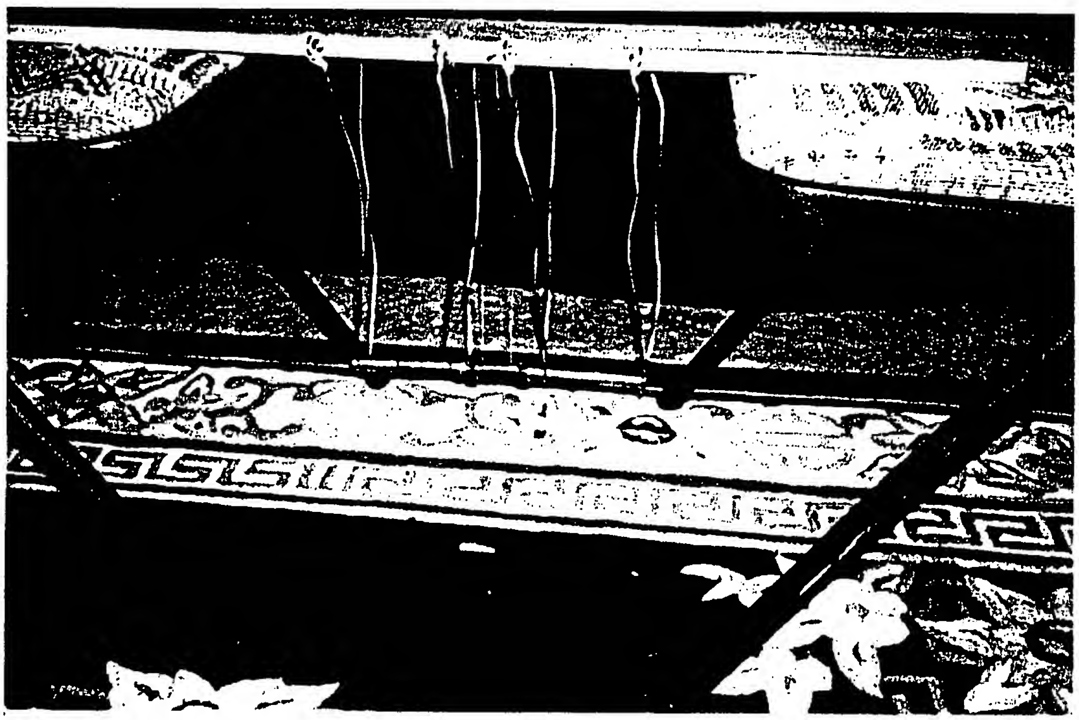

Figure 2

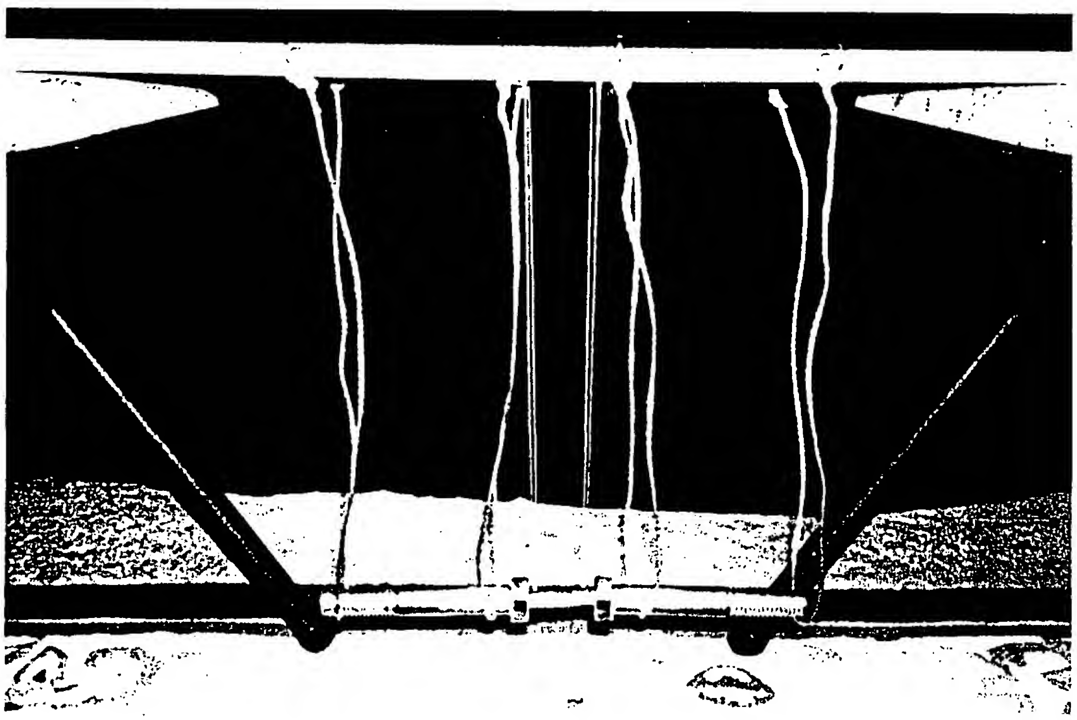

Figure 3

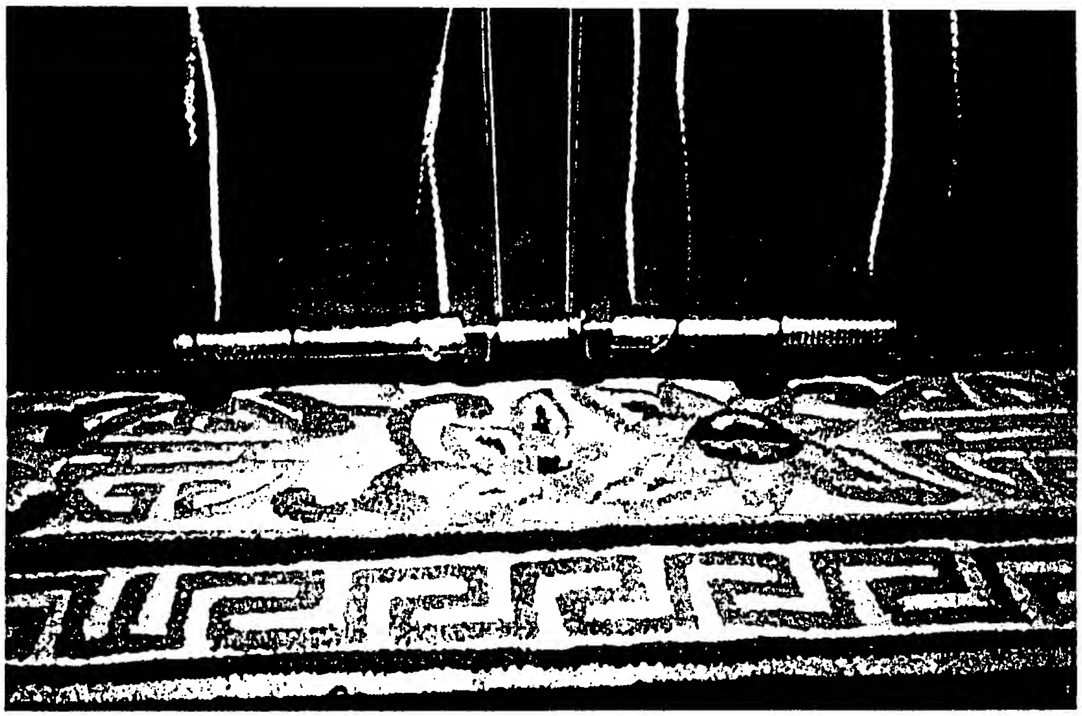

Figure 4

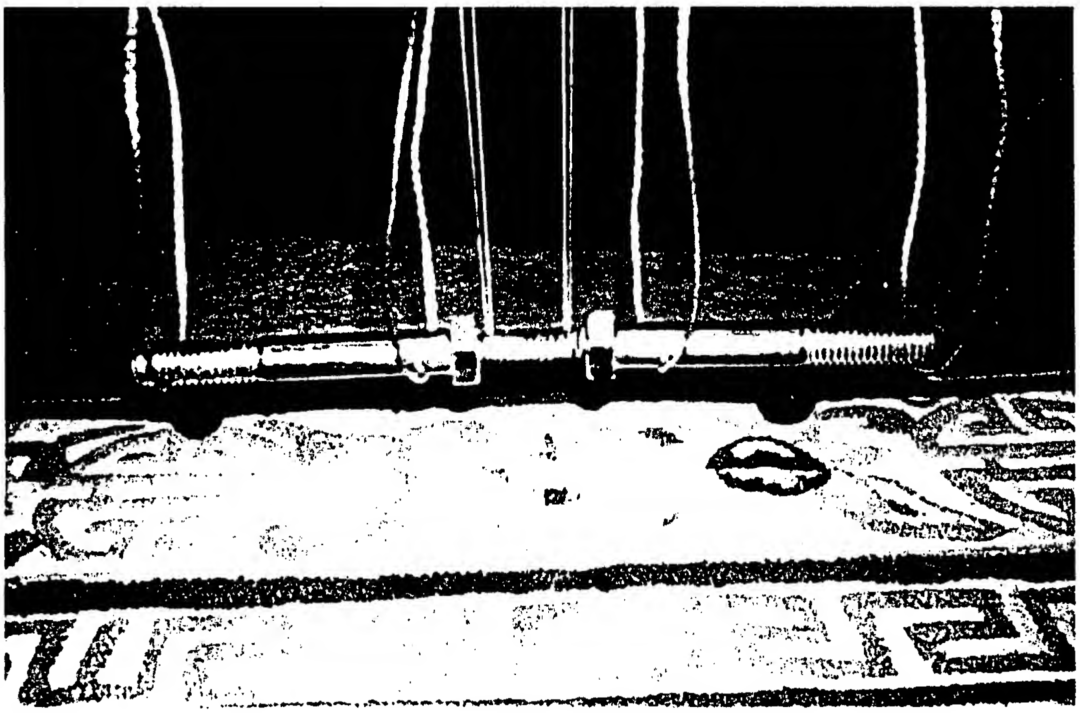

Figure 5

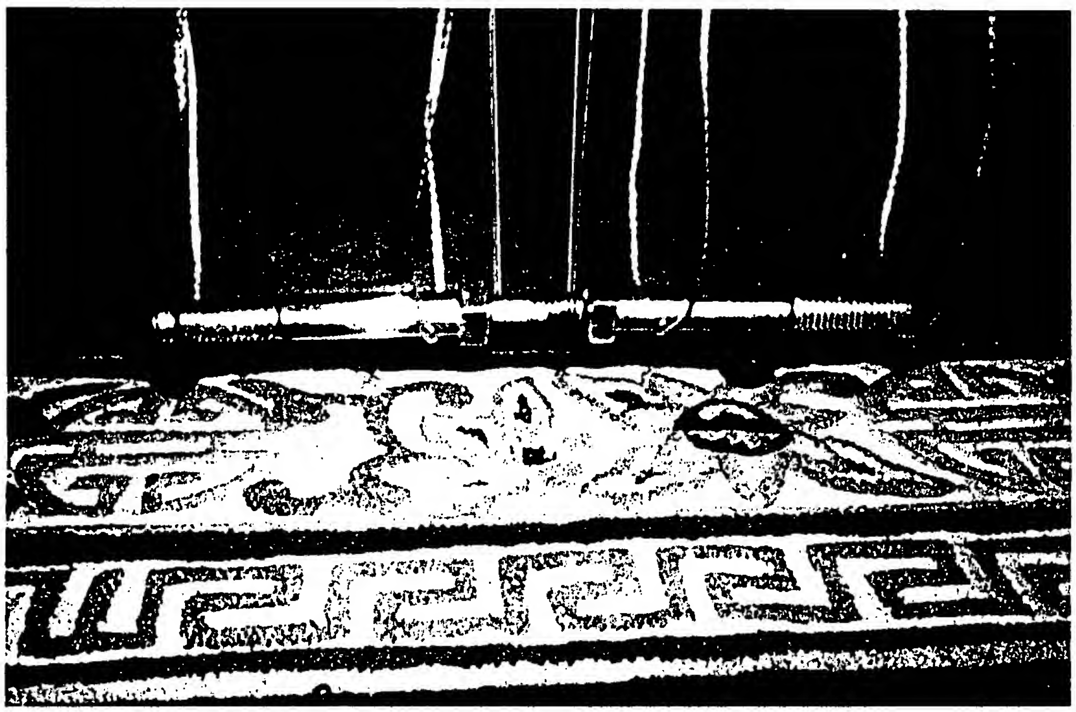

Figure 6

Claims on Appeal

What is claimed is:

1. A device for converting kinetic energy into electrical energy comprising, a first moving system, a second moving system for relative movement toward and away from said first moving system, an object for transfer between said first moving system and said second moving system for developing the kinetic energy relative thereto, means for converting the kinetic energy from said object at second moving system into electrical energy.

2. A device according to claim 1 further comprising discharge means for transferring said kinetic energy extracted object from said second moving system to said first moving system to develop the kinetic energy relative to said second moving system, and further kinetic energy extracting means for converting kinetic energy from said object at said first moving system into electrical energy.

3. A device according to claim 1 wherein said object is magnetizable.

4. A device according to claim 1 wherein said object is a rod for selective reciprocation between said first and second moving systems.

5. A device according to claim 3 wherein said means for converting the kinetic energy from said object into electrical energy has an electrically conductive coil.

6. A device according to claim 2 wherein said discharge means has an electrically conductive coil.

7. A device according to claim 1 wherein said first and second moving systems each have respective drive shafts coupled thereto, fly-wheels connected to said drive shafts and driven thereby, each of said fly-wheels having gear teeth, gears meshing with said fly-wheel gear teeth, driven by and driving said meshing gears for selectively producing electrical energy and kinetic energy.

8. A device according to claim 4 wherein said rod comprises a shaft having a transverse array of ridges formed along the length thereof, and an end to said shaft, a tube for said second moving system for selective mating with said shaft, said tube having openings formed therein, and gears protruding through said respective openings, said gears meshing with said ridges and being driven thereby as said shaft reciprocates between said first and second moving systems, motor generators coupled to said gears and being driven thereby to selectively produce electrical power and to drive said shaft.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **DONALD GILBERT CARPENTER** **Art Unit: 2834**

Serial No.: **09/935,936**

Filed: August 23, 2001

For: ***Energy Conversion Technique*** **Examiner: Nicolas Ponomarenko**

Appeal Brief

Honorable Commissioner of Patents
Post Office Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith, in triplicate, is applicant's Brief on Appeal in the above-identified matter.

(1) Real Party in Interest:

The applicant named in the caption of this Brief, DONALD GILBERT CARPENTER, is the real party in interest.

(2) Related appeals and Interferences:

None.

(3) *Status of Claims:*

Claims 1 through 8, inclusive, are pending in this application. No claims have been cancelled and pending claims 1 through 8, inclusive, are on appeal.

(4) Status of Amendments Filed Subsequent to Final Rejection:

None.

(5) *Summary of Invention:*

As illustrated in Fig. 3, apparatus for converting kinetic energy into electrical energy has a first moving system 21 and a second moving system 22 (Specification, p. 18, para. 73, lines 21 to 25). The second moving system 22 moves toward and away from the first moving system 21 (Specification, p. 18, para. 73, line 25 to p. 19, line 5).

Objects 46, 47 are ejected electromagnetically by ejectors 38, 40 from respective openings 30, 32 in face 25 of the moving system 21 in the direction of arrow 48 (Specification, p. 19, para. 74, lines 6 to 14). The openings 30, 32, in the face of the first moving system, are aligned with receptor openings 35, 37 (Fig.5) in the second moving system 22 (Specification, p. 17, Para. 74, lines 17 to 21). The objects 46, 47 (Fig. 1) are magnetized (specification, p. 18, para. 76, lines 20 to 25). The openings 35, 37 in the second moving system 22, moreover, house respective receptor conductive coils (only receptor coils 43, 44 are shown in the drawing) for converting the kinetic energy of the individual incoming objects 46, 47 into electrical energy (Specification, p. 17, para. 74, lines 9 to 21).

Among alternative embodiments of the invention, attention is invited to Fig. 6 which shows rods (unnumbered) that extend to both of the moving systems 21, 22. At the same time, the moving systems 21, 22 are each connected, respectively, to drive shafts 51, 52 and 51A, 52A (Specification, p. 23, para.93, lines 15 to 20). Illustrated, moreover, in connection with this alternative embodiment of the invention is fly-wheel 53, coupled to the drive shafts 51, 51A and a fly-wheel 54, coupled to the drive shafts 52 and 52A (Specification, p. 23, para. 93, lines 20 to 22). Gear teeth 58 on the fly-wheel 53 and gear teeth 59 on the fly-wheel 54 are provided for electrical or kinetic energy generation (Specification, p. 23, para. 93, line 30 to p. 24, line 2 and p. 24, para. 95, lines 24 and 25).

Turning now to Figs. 8A and 8B, an alternative rod 71 can be used in substitution for the objects 46, 47 illustrated in Fig. 3. Thus, as shown in Fig. 8A, teeth 70 along the length of the rod 71 form a rack that engages (Fig. 8B) pinion gears 84 (Specification, p. 25, para. 99, line 26 to p. 26, line 15). The functions served by the rod 71 are four-fold.

1. Electric motors (not shown in the drawing) drive the pinion gears 84 to eject the rod 71 from its associated moving system;
2. The electric motors are driven during a reverse reciprocation by the action of the rack 70 and pinion gears 84 to change their function and act as dynamos to produce electrical power;
3. The gears 84 can freewheel, if the purpose if to provide release of the rod 71; and
4. To remain motionless, with respect to the associated moving system in that part of the cycle in which the moving systems 21, 22 (Fig. 3) draw away from each other and move toward each other.

(6) Issues:

Does the claimed invention satisfy the "utility" requirement for patentability as expressed in 35 U.S.C. Section 101?

(7) Grouping of Claims:

Each of the eight claims in issue are independently patentable and do not stand or fall together for the reasons advanced in (8), below.

(8) Argument:

Grouping of Claims: Absent application of prior art to the eight claims in issue, applicant is compelled to assert that those claims, because they each recite separate structural features of the invention are individually patentable and do not stand or fall together.

Rejection Under 35 U. S.C. Section 101: To reject all eight claims on appeal, the position has been asserted that the invention is inoperative because it contradicts the principle of conservation of energy (Final Rejection 7/24/03, p. 2, para. 2, lines 5 to 8). Further in this respect, the principle of conservation of energy is restated in the final rejection as a "....statement that the sum total of the energy of the universe is a fixed and unalterable quantity." (Final Rejection, 7/24/03, p. 2, para. 2, lines 10 to 12).

Ordinarily, it is sufficient to say that energy cannot be created or destroyed. In reference to the universe, however, this commonly accepted reference to a principle of conservation of energy is not correct. The proper "conservation" statement is as a principle of mass/energy conservation, because mass and energy are interchangeable, energy being equal to the product of mass and the square of the speed of light:

$$E=MC^2$$

Where:

E= energy
M= mass
C= *speed of light*

Attention in this respect, is invited to Attachment A, appended hereto (McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition, S. P. Parker, Ed., New York, 1994, p. 1217) which establishes the correct conservation definition as one of mass-energy conservation.

Further in support of the correct conservation statement, please note the following passage, quoted from "Theoretical Physics," F. Woodbridge Constant, Addison-Wesley Publishing Company, Inc., Reading, 1958, p. 317 (Attachment B):

> "The basic conservation principle then is the *conservation of mass-energy.*" (Author's italics)

Consequently, because of this interchangeability between mass and energy, it is not correct to state that the sum total of the energy in the universe is a fixed and unalterable quantity. As developed immediately below, moreover, it is even incorrect to revise the foregoing statement to read that the sum total of the mass/energy of the universe is a fixed, unalterable quantity.

For example, please consider carefully, the following quotation from "Principles of Physical Cosmology, P. J. E. Peebles, Princeton University Press, Princeton, 1993, p. 139 (Attachment C):

> *However, since the volume of the universe varies as $a(t)^3$, the net radiation* energy in a closed universe decreases as *$1/a(t)$* as the universe expands. Where does the lost energy go? .. The resolution of this apparent paradox is that while energy conservation is a good local concept, as in equation (6.18), and can be defined more generally in the special case of an isolated system in asymptotically flat space, there is not a general global energy conservation law in general relativity theory.

Consequently, in accordance with information available on current developments in modern physics, the sum total of the energy or even mass/energy of the universe is *not* a fixed, unalterable quantity.

The Board's attention now is invited to Attachment D, which is a copy of a brief, popular science article published in the August, 2003 Edition of the "National Geographic" magazine. This article summarizes in laymen's terms a number of current speculations by informed cosmologists about the size and nature of the universe.

None of these speculations can be construed to even suggest that "..... the sum total of the energy of the universe is a fixed unalterable quantity." At best, the "National Geographic" article underscores the quandary in present cosmological thought about the character of the universe. Clearly, at this passage in our knowledge there is no support at all for any thought or conjecture about the status of the energy (or even mass/energy) composition of the universe.

Accordingly, applicant respectfully submits that the rejection of claims1 through 8 for failure to satisfy the "utility" requirement under 35 U. S. C. Section 101 is based:

1. On a demonstrably inappropriate "conservation" statement. Properly xpressed, it is a law of conservation of mass/energy and not a law of energy conservation; and

2. The flawed attempt to interpret an inappropriate conservation statement to establish that the sum total of the universe 's energy is a fixed, unalterable quantity, is a position that directly contradicts stablished cosmological analysis.

In this circumstance, applicant respectfully submits that the final rejection of Claims 1 through 8, inclusive, for lack of utility under 35 U. S. C. Section 101 is based on an incorrectly stated physical principle that is invalid with respect to the universal environment to which it was applied in the final rejection and should be withdrawn. The final rejection then concludes:

1. That the invention contradicts known scientific principles or relies on a previously undiscovered scientific phenomenon; and
2. That the burden shifts to applicant to demonstrate that the claimed invention is operable; or that the basic scientific principles are incorrect, or does not violate *basic scientific principles.*

The rejection then cites "Manual of Patent Examining Practice "(MPEP) Section 608.03, (Attachment E), to support a requirement to furnish a working model of the invention.

In this connection, the interesting dichotomy that characterizes MPEP Section 608.3 should be considered.

Thus:

Nature of the Objection	Proof of Operativeness
1. Perpetual motion machine	Working model
2. Operativeness questioned	Applicant may choose his way of proving operativeness.

Although a gratuitous reference to perpetual motion machines is made in the final rejection, this remark is not applied either to the application or to the eight claims in issue. Consequently, under the terms of MPEP Section 608.03, there is no ground for requiring applicant to furnish a working model of his invention, and this requirement should be withdrawn.

The final rejection, however, does state that the description in the application is inoperative because it "contradicts known scientific principles". Applicant urges that the foregoing energy conversion analysis clearly establishes not that the conservation law is wrong, but has been misapplied and restated in a manner contrary to current cosmological thinking. In this respect, and in accordance with the specific provisions of MPEP Section 608.03, applicant exercised his right to prove "operativeness" through a simple physical experiment. This experiment was reported in detail in applicant's declaration under 37 C. F. R. Section 132 that was filed in the Patent and Trademark Office on March 7, 2003 (Attachment F) in response to the first substantive Official Action issued in this case.

Kindly note in Applicant's Rule 132 Declaration, the following salient points:

1. Applicant's professional credentials, illustratively; a doctorate in nuclear engineering; Associate Professor of Physics at the United States Air Force Academy for seven years; full professorships in physics and electrical engineering; recipient of the Theodore Von Karman Award for science and engineering; author of twenty-seven scientific books and papers certainly qualify the inventor as a person who knows whereof he writes (cf Rule 132 Declaration, P. 1, lines 3 to p. 2, line 4); and

2. The consequence of the experiment reported in the Rule 132 Declaration is that an extra increment of energy, $2E_{2A}$, is observed and that this energy increment is not to be expect d through th usual kinetic energy analysis of two bodies moving toward each other (cf Rule 132 Declaration, P. 4, lin 11).

The final rejection, however, failed to address, rebut or refute this experimental data.

The explanation for this effect, as experimentally verified in the Rule 132 Declaration, is summarized in the application as filed, p. 2, para. 6, lines 7 to 11,

> An illustrative embodiment of the invention arises from the fact that the kinetic energy of a system of masses in motion relative to each other is different from the kinetic energy of that same system when measured relative to some point outside of the 'moving' system (i. e. a 'stationary' system) that is receding or *advancing relative to the 'moving' system.*

In compliance with MPEP Section 1206, moreover, this rejection under 35 U. S. C. Section 101 does not require applicant to specify particular claim limitations to overcome the final rejection.

In summary, it is respectfully urged that:

1. In the universal terms stated in the final rejection, a law of conservation of energy is incorrect; and
2. To interpret the law of conservation of energy as establishing that the energy of the universe is a fixed, unalterable quantity is in complete disregard of the present state of cosmological thought.

Ergo, the rejection of this application (and claims 1 through 8) as lacking "utility" under 35 U. S. C. Section 101 is in error and should be withdrawn.

Because the application is rejected on the ground that it describes an invention that contradicts known scientific principle, applicant has exercised his right under MPEP Section 608.03 to overcome this rejection by submitting a Rule 132 Declaration. In that Rule 132 Declaration, applicant, a scientist with outstanding professional credentials, produced data that demonstrated the appearance of an increment of energy, $2E_{2A}$, in accordance with the principles of the invention.

As a result, the Board is earnestly solicited to withdraw the working model requirement under MPEP Section 608.03, withdraw the rejection under 35 U. S. C. Section 101; and pass this application to issue.

Respectfully submitted,

LANGDALE & VALLOTTON, LLP

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Fifth Edition

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On the c ver: Photoml rograph of crystals f vitamin B_1.
(Dennis Kunkel, University of Hawaii)

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In addition, material has been drawn from the following references: R. E. Huschke, *Glossary of Meteorology*, American Meteorological Society, 1959; *U.S. Air Force Glossary of Standardized Terms*, AF Manual 11-1, vol. 1, 1972; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, 1st ed., National Aeronautics and Space Administration, 1965; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology, White Sands Missile Range, New Mexico*, National Bureau of Standards, AD 467-424; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, 1st ed., Department of Defense, 1967; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission; F. Casey, ed., *Compilation of Terms in Information Sciences Technology*, Federal Council for Science and Technology, 1970; *Glossary of Stinfo Terminology*, Office of Aerospace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Technical, and Imperative Terms*, Bureau of Naval Personnel, 1962; *ADP Glossary*, Department of the Navy, NAVSO P-3097.

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[illegible] and not on its chemical composition. Also known as [illegible]'s mass absorption law. { 'mas əb'sȯrp·shən ¦lȯ }

[illegible] action law [PHYS CHEM] The law that the rate of a [illegible]cal reaction for a uniform system at constant temperature [illegible]portional to the concentrations of the substances reacting. [illegible] known as Guldberg and Waage law. { 'mas ¦ak·shən ,lȯ }

[illegible] [COMPUT SCI] To process data, primarily to convert [illegible] a more useful form or into a form that will simplify [illegible]ssing. [MED] The act of rubbing, kneading, or stroking [illegible] superficial parts of the body with the hand or with an instru[illegible] for therapeutic purposes. { mə'säzh }

[illegible]-analyzed ion kinetic energy spectrometry [SPECT] [illegible] of ion kinetic energy spectrometry in which the ionic [illegible] undergo mass analysis followed by energy analysis. [illegible]viated MIKES. { 'mas ¦an·ə,līzd 'ī,än kə¦ned·ik 'en·ər·jē [illegible]trē }

[illegible] attraction vertical [GEOPHYS] The vertical which is a [illegible] only of the distribution of mass and is unaffected by [illegible] resulting from the motions of the earth. { 'mas ə¦trak· [illegible],vərd·ə·kəl }

[illegible] burning rate [CHEM ENG] The loss in mass per unit [illegible] by materials burning under specified conditions. [ORD] [illegible] of consumption of propellant charge, usually expressed in [illegible] per second. { 'mas 'bərn·iŋ ,rāt }

[illegible] color See masstone. { ¦mas ¦kəl·ər }

[illegible] communication [COMMUN] Communication which is [illegible] to or reaches an appreciable fraction of the population. [illegible] kə,myü·nə'kā·shən }

[illegible] concrete [CIV ENG] Concrete set without structural [illegible]cement. { 'mas 'kän,krēt }

[illegible] conversion [COMPUT SCI] The transfer of data from [illegible] computer system to another, in which all the data is con[illegible] in a single operation, rather than in gradual increments. [illegible] kən,vər·zhən }

[illegible] data multiprocessing [COMPUT SCI] The basic con[illegible] of time sharing, with many inquiry stations to a central [illegible] capable of on-line data retrieval. { 'mas ¦dad·ə ,məl· [illegible] }

[illegible] defect [NUC PHYS] The difference between the mass of [illegible] and the sum of the masses of its individual components [illegible] free (unbound) state. { 'mas 'dē,fekt }

[illegible] distance [ENG] The mass carried by a vehicle multi[illegible] by the distance it travels. { 'mas ¦dis·təns }

[illegible]vergence [FL MECH] The divergence of the momen[illegible], a measure of the rate of net flux of mass out of a unit [illegible] of a system; in symbols, $\nabla \cdot \rho V$, where ρ is the fluid [illegible], V the velocity vector, and ∇ the del operator. { 'mas [illegible] }

[illegible] [FOOD ENG] Sugar industry term for sugar-mo[illegible] mixture prior to the removal of the molasses. [illegible] }

[illegible]gy conservation [RELAT] The principle that en[illegible] be created or destroyed; however, one form of [illegible] that which a particle has because of its rest mass, equal [illegible] times the square of the speed of light. { 'mas 'en· [illegible],vā·shən }

[illegible]gy relation [RELAT] The relation whereby the to[illegible] content of a body is equal to its inertial mass times [illegible] of the speed of light. { 'mas 'en·ər·jē ri,lā·shən }

[illegible] See quadrupole spectrometer. { 'mäs·ən,fil·tər }

[illegible] [GEOL] A process in which the direct appli[illegible]tational body stresses causes earth and rocks to [illegible] carried downslope. Also known as gravity erosion. [illegible] }

[illegible] [ANAT] The masticatory muscle, arising from the [illegible] arch and inserted into the lower jaw. { mə'sēd·ər }

[illegible] See faunal extinction. { 'mas ik'stiŋk·shən }

[illegible] [ATOM PHYS] A formula for the probability [illegible] atom approaching the surface of a metal will [illegible] electrons. { 'mas·ē ,fȯr·myə·lə }

[illegible] [ENG] A pattern of powder flow occurring in hop[illegible] characterized by the powder flowing at every point, [illegible] adjacent to the hopper wall. [FL MECH] The [illegible] in motion which crosses a given area in a unit [illegible] }

[illegible] [ENG] A bin whose hopper walls are suffi[illegible] and smooth to cause flow of all the solid, without [illegible] whenever any solid is withdrawn. { 'mas ¦flō

mass fl wmeter [ENG] An instrument that measures the mass of fluid that flows through a pipe, duct, or open channel in a unit time. { 'mas ¦flō,mēd·ər }

mass formula [NUC PHYS] An equation giving the atomic mass of a nuclide as a function of its atomic number and mass number. { 'mas ,fȯr·myə·lə }

mass-haul curve [CIV ENG] A curve showing the quantity of excavation in a cutting which is available for fill. { 'mas ¦hȯl ,kərv }

mass heaving [GEOL] A comprehensive expansion of the ground due to freezing. { 'mas 'hēv·iŋ }

massicot [MINERAL] PbO A yellow, orthorhombic mineral consisting of lead monoxide; found in the western and southern United States. Also known as lead ocher. { 'mas·ə,kät }

Massieu function [THERMO] The negative of the Helmholtz free energy divided by the temperature. { ma'syü ,fəŋk·shən }

massif [GEOL] A massive block of rock within an erogenic belt, generally more rigid than the surrounding rocks, and commonly composed of crystalline basement or younger plutons. { ma'sēf }

massive [GEOL] Of a mineral deposit, having a large concentration of ore in one place. [MINERAL] Of a mineral, lacking an internal structure. [PALEON] Of corallum, composed of closely packed corallites. [PETR] **1.** Of a competent rock, being homogeneous, isotropic, and elastically perfect. **2.** Of a metamorphic rock, having constituents which do not show parallel orientation and are not arranged in layers. **3.** Of igneous rocks, being homogeneous over wide areas and lacking layering, foliation, cleavage, or similar features. { 'mas·iv }

mass law of sound insulation [CIV ENG] The rule stating that sound insulation for a single wall is determined almost wholly by its weight per unit area; doubling the weight of the partition increases the insulation by 5 decibels. { 'mas 'lȯ əv 'sau̇nd ,in·sə,lā·shən }

mass-luminosity relation [ASTROPHYS] A relation between stellar magnitudes and mass of the stars; when the absolute magnitudes of stars are plotted versus the logarithms of their masses, the points fall closely along a smooth curve. { 'mas ,lü·mə'näs·əd·ē ri,lā·shən }

mass-memory unit [COMPUT SCI] Drum or disk memory that provides rapid access bulk storage for messages that are awaiting availability of outgoing channels. { 'mas 'mem·rē ,yü·nət }

mass movement [GEOL] Movement of a portion of the land surface as a unit. { 'mas 'müv·mənt }

mass number [NUC PHYS] The sum of the numbers of protons and neutrons in the nucleus of an atom or nuclide. Also known as nuclear number; nucleon number. { 'mas ,nəm·bər }

mass operator [QUANT MECH] An operator which is added to the Lagrangian in a quantized field theory in order to eliminate certain infinite quantities, and whose sum with the mechanical mass gives the observed mass. { 'mas 'äp·ə,rād·ər }

mass ratio [AERO ENG] The ratio of the mass of the propellant charge of the rocket to the total mass of the rocket when charged with the propellant. { 'mas 'rā·shō }

mass reactance *See* acoustic mass reactance. { 'mas rē'ak·təns }

mass reflex [PHYSIO] A spread of reflexes suggesting lack of control by higher cortical centers; seen in normal newborns, in persons under the influence of drugs or in severe emotional states, and in encephalopathy or high spinal cord transections. { 'mas 'rē,fleks }

mass renormalization [QUANT MECH] The mathematical operation of adding the mass which a particle possesses because of its self interaction, to its mechanical mass in order to obtain its measured mass. { 'mas rē,nȯr·mə·lə'zā·shən }

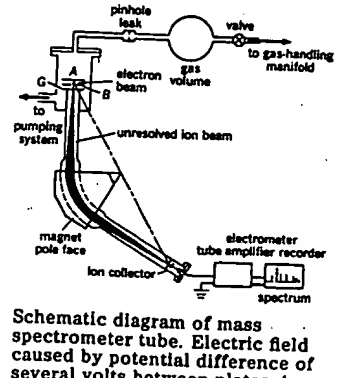
mass resistivity [ELEC] The product of the electrical resistance of a conductor and its mass, divided by the square of its length; the product of the electrical resistivity and the density. { 'mas ,rē,zis'tiv·əd·ē }

mass shift [NUC PHYS] The portion of the isotope shift which results from the difference between the nuclear masses of different isotopes. { 'mas 'shift }

mass spectrograph [ENG] A mass spectroscope in which the ions fall on a photographic plate which after development shows the distribution of particle masses. { 'mas 'spek·trə,graf }

mass spectrometer [ENG] A mass spectroscope in which a slit moves across the paths of particles with various masses, and

MASS SPECTROMETER



Schematic diagram of mass spectrometer tube. Electric field caused by potential difference of several volts between plates *A* and *B* draws ions through slit in *B*. Ions are further accelerated by potential difference of hundreds or thousands of volts between *B* and *G*.

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NEERING

THEORETICAL PHYSICS

Thermodynamics, Electromagnetism, Waves, and Particles

by

F. WOODBRIDGE CONSTANT

Jarvis Professor of Physics
Trinity College

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again tells us that no material object can attain a speed equal to or greater than the speed of light.

Since objects in everyday life do not have speeds at all close to that of light, their variation of mass with velocity is not measurable. However, in the case of such small particles as the electron, proton, deuteron, etc., it has been possible to verify Eq. (14–27) experimentally. A beta particle from a radioactive source, or an electron accelerated to a high energy in a betatron, may have a speed sufficient for its apparent mass to be several times its rest mass. For the heavier proton to show a mass increase of the same proportion as that for an electron, the energy of the proton must be 1840 times as great; nevertheless our powerful proton accelerators, such as the synchrotron and cosmotron, reach energies well past the threshold beyond which mass variation must be taken into account.

14–11 Einstein's mass-energy relationship. We have seen that relativity requires that Newton's law of motion must be expressed as in Eq. (14–24) and that at the same time we must take m to vary in accord with Eq. (14–27). With m variable, Eq. (14–24) may be written as

$$\mathbf{F} = \frac{d}{dt}(m\mathbf{v}) = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt} = m\mathbf{a} + \mathbf{v}\frac{dm}{dt}. \tag{14–28}$$

We see that the equation $\mathbf{F} = m\mathbf{a}$ does not hold at high speeds if we take $m = m_0$, nor is it valid in general if we take m to be the apparent mass. In fact, if $\mathbf{v}$ and $\mathbf{a}$ are in the *same* direction, we find (see problem 6 at end of this chapter) that

$$\mathbf{F} = \frac{m_0}{(1 - v^2/c^2)^{3/2}}\,\mathbf{a}, \tag{14–29}$$

where $m_0/(1 - v^2/c^2)^{3/2}$ is called the *longitudinal inertial mass*. Inertial mass is defined as the ratio F/a. On the other hand, if $\mathbf{F}$ is perpendicular to $\mathbf{v}$, the inertial mass is found to be the same as the apparent mass given by Eq. (14–27). NOTE

From the conservation of energy principle, we take the kinetic energy of a moving body to be the work done by the force that accelerates the body from rest. If we retain the definition of work as force times distance, and assume linear motion, we have

$$\text{K.E.} = \int_{v=0}^{v=v} F\,ds = \int_0^v \frac{d}{dt}(mv)\,ds = \int_0^v \frac{d}{dt}(mv)\frac{ds}{dt}\,dt$$

$$= \int_0^v v\frac{d}{dt}(mv)\,dt = \int_0^v v\,d(mv).$$

Substituting for m from Eq. (14–27) and integrating, we get

$$\text{K.E.} = \int_{v=0}^{v=v} v\, d\left(\frac{m_0 v}{\sqrt{1 - v^2/c^2}}\right)$$

$$= m_0 \int_0^v \left[\frac{1}{\sqrt{1 - v^2/c^2}} + \frac{v^2}{c^2(1 - v^2/c^2)^{3/2}}\right] v\, dv$$

$$= m_0 \int_0^v \frac{v\, dv}{(1 - v^2/c^2)^{3/2}} = m_0 c^2 \left|\frac{1}{(1 - v^2/c^2)^{1/2}}\right|_0^v$$

$$= m_0 c^2 \left(\frac{1}{\sqrt{1 - v^2/c^2}} - 1\right). \tag{14–30}$$

This is the *relativistic expression for kinetic energy*. If the first term is expanded by the binomial theorem, we find that

$$\text{K.E.} = m_0 c^2 \left(1 + \frac{1}{2}\frac{v^2}{c^2} + \frac{3}{8}\frac{v^4}{c^4} + \cdots - 1\right),$$

which reduces to the familiar $\frac{1}{2}m_0 v^2$ of Newtonian dynamics when $v \ll c$.

Equation (14–30) may be rewritten as

$$\text{K.E.} = mc^2 - m_0 c^2 = (m - m_0)c^2. \tag{14–31}$$

Thus the kinetic energy of a moving body equals its gain in mass times c^2. We may also say that the apparent mass of a body increases linearly with its kinetic energy, so that an increase in mass is an indication and measure of the gain in kinetic energy. It is also found* that an increase in the potential energy of a system of particles is accompanied by a similar increase in mass equal to the gain in energy divided by c^2. Therefore we may say, in general, that *the gain (or loss) in the energy of a system is equal to the gain (or loss) in its apparent mass multiplied by c^2.*

We may go one step further and interpret the term $m_0 c^2$ in Eq. (14–31) as the *rest energy* of a body whose rest mass is m_0. This rest energy may be regarded as a form of internal energy inherent in the nature of the particles out of which matter is composed. Then

$$mc^2 = \text{rest energy} + \text{kinetic energy}$$
$$= \text{total energy}.$$

If here we let E stand for the total energy, we arrive at Einstein's famous *principle of the equivalence of mass and energy.*

$$E = mc^2. \tag{14–32}$$

The value of any theory is measured by its success in predicting new results. In this respect Einstein's theory has been outstanding. In nuclear physics the equivalence of mass and energy has been put to the test repeatedly and it has always been confirmed. With the ability to measure the masses of atomic particles to a high degree of accuracy, nuclear physicists have been able to predict the energy changes accompanying nuclear and particle transmutations, and they have also been able to verify their predictions experimentally. The whole subject of nuclear energy (popularly called "atomic energy") illustrates the usefulness of the above principle. The energy exchanges involved in chemical reactions must also be accompanied by corresponding mass changes, but in this relatively low-energy field the mass changes are too small to be detected experimentally.

While chemical reactions and most nuclear ones involve a rearrangement of atomic or subatomic particles, the electron-positron and the proton-antiproton reactions are exceptions. In the latter two cases, physicists apply the mass-energy equivalence principle in various ways. Some say that when an electron and positron are annihilated, their rest mass is converted into energy in the form of radiation called gamma rays; however, we shall see in the next chapter that gamma rays may be considered to be photons or light particles, which, because of their energy, carry with them the momental mass originally associated with the electron and positron. It would seem preferable to regard energy as a property of mass, or mass as a property of energy, the two being inseparable. The basic conservation principle then is the *conservation of mass-energy.*

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*See Richtmeyer, Kennard, and Lauritsen, *Introduction to Modern Physics*, 5th ed., pp. 69–70.

EXAMPLE. An electron and positron which are practically at rest come together and annihilate each other, producing two photons of equal energy. Find the energy and equivalent mass of each photon.

Solution. The rest mass m_0 of an electron is 9.1×10^{-31} kg. This is equivalent (in the mks system) to the energy

P.J.E. PEEBLES

Principles of Physical Cosmology

Princeton Series in Physics

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P.J.E. PEEBLES

During the last twenty years, dramatic improvements in methods of observing astrophysical phenomena from the ground and in space have added to our knowledge of what the universe is like now and what it was like in the past, going back to the hot big bang. In this overview of today's physical cosmology, P.J.E. Peebles shows how observation has combined with theoretical elements to establish the subject as a mature science, while he also discusses the most notable recent attempts to understand the origin and structure of the universe. A successor to Peebles's classic volume *Physical Cosmology* (Princeton, 1971), the book is a comprehensive overview addressed not only to students but also to scientists active in fields outside cosmology.

The first part of the work presents the elements of physical cosmology, including the history of the discovery of the expanding universe. The second part, on the cosmological tests that measure the geometry of spacetime, discusses general relativity theory as the basis for the tests, and then surveys the broad variety of ways the tests can be applied with the new generations of telescopes and detectors. The third part deals with the origin of galaxies

(continued on back flap)

(continued from front flap)

and the large-scale structure of the universe, and reviews ideas about how the evolution of the universe might be traced back to very early epochs when structure originated. Each chapter begins with an introduction that can be understood with no special knowledge beyond undergraduate physics, and then progresses to more specialized topics.

P.J.E. PEEBLES is Albert Einstein Professor of Science at Princeton University. He is a Fellow of the American Academy of Arts and Sciences and the Royal Society.

PRINCETON SERIES IN PHYSICS
Philip W. Anderson, Arthur S. Wightman, and Sam B. Treiman, Editors

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The Large-Scale Structure of the Universe

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The second step follows from the change of variables $x=\hbar\omega/kT$, with the dimensionless integral

$$I_- = \int_0^\infty \frac{x^3\,dx}{e^x-1} = \frac{\pi^4}{15}. \tag{6.15}$$

Equation (6.14) is the Stefan-Boltzmann law. We will use the standard symbol, a, for Stefan's constant when it is easily distinguished from the expansion parameter.

The heat capacity of the CBR at fixed volume is $4aT^3$. If the matter consists of atomic hydrogen, the ratio of its heat capacity to that of the CBR is

$$\frac{1.5n_Bk}{4aT^3} = 4\times10^{-9}\Omega h^2, \tag{6.16}$$

where n_B is the mean number density of hydrogen atoms (eq. [5.68]). This ratio is independent of redshift. Its small value explains why the CBR might be expected to have a closely thermal spectrum: at high redshifts, where the interaction between matter and radiation is appreciable, the matter relaxes to the radiation temperature, because the radiation has by far the higher heat capacity, and at thermal equilibrium the radiation spectrum remains thermal no matter how strong the interaction.

The ratio of the mean mass density in matter (eq. [5.67]) to the mass density in the CBR at the temperature in equation (6.1) is

$$\frac{\rho_b c^2}{aT^4} = 4.0\times10^4\,\Omega h^2(1+z)^{-1}. \tag{6.17}$$

The redshift dependence follows because the energy density in the CBR varies as $(1+z)^4$ (because $T\propto 1/a(t)$ in eq. [6.4]), one power faster than for the nonrelativistic matter. With the lower bound on the mass density parameter Ω in equation (5.150), we see that at the present epoch the energy density in the radiation is a small fraction of the total. It follows that when the redshift is not too large the energy available from annihilation of mass by nuclear burning (or perhaps by the more efficient process of accretion by black holes) is sufficient to produce an appreciable perturbation to the radiation temperature. Whether this can have happend depends on whether there is a way to transfer the energy to the CBR while keeping the spectrum close to thermal. Some details on how this might happen are discussed in the next section and in section 24.

Two features in the standard interpretation of the CBR tend to be confusing. We have already noted in section 1 that the name for the standard model, the hot big bang, is misleading, for a bang suggests a localized explosion. In the standard picture the source of the CBR is not localized; the radiation is uniformly and isotropically distributed throughout the space we can observe. This agrees with

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The second confusing point is the r
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$$\frac{d\rho_\gamma}{dt} = - \quad = -$$

The solution is

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Discovery

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the fact that the radiation is equally bright in all directions. The number density of photons is decreasing with time as $a(t)^{-3}$, not because photons are leaving the universe—there is nowhere else to go—but because the volume of space is increasing as $a(t)^3$.

The second confusing point is the nature of energy balance in the CBR. Since the energy density in blackbody radiation varies as the fourth power of the temperature, the expansion of the universe causes the radiation energy density to evolve as $\rho_\gamma \propto T^4 \propto a(t)^{-4}$. As indicated in equation (6.17), this is faster by one power of the expansion parameter than for the mass density in a gas of nonrelativistic particles such as baryons (eq. [5.19]). The number density of photons varies as $a(t)^{-3}$, as for baryons, but there is an extra factor of $1/a(t)$ for the redshift of the mean energy per photon. Another way to get the cooling law is to recall that the pressure of the radiation is $p_\gamma=\rho_\gamma/3$. With this equation of state, the local energy conservation equation (5.16) is

$$\begin{aligned}\frac{d\rho_\gamma}{dt}&=-3(\rho_\gamma+p_\gamma)\frac{\dot a}{a}\\ &=-4\rho_\gamma\frac{\dot a}{a}.\end{aligned} \qquad (6.18)$$

The solution is

$$\rho_\gamma \propto a(t)^{-4}, \qquad (6.19)$$

consistent with the Stefan-Boltzmann law (6.14) and the redshift law (6.4) for the radiation temperature. We see that the faster decrease of ρ_γ compared to the mass density of a nonrelativistic gas is the result of the pressure work done by the expanding radiation. However, since the volume of the universe varies as $a(t)^3$, the net radiation energy in a closed universe decreases as $1/a(t)$ as the universe expands. Where does the lost energy go? Since there is no pressure gradient in the homogeneously distributed radiation, the pressure does not act to accelerate the expansion of the universe. (The active gravitational mass due to the pressure has the opposite effect, slowing the rate of expansion, as indicated in eq. [5.15]). The resolution of this apparent paradox is that while energy conservation is a good local concept, as in equation (6.18), and can be defined more generally in the special case of an isolated system in asymptotically flat space, there is not a general global energy conservation law in general relativity theory.

Discovery

The history of the discovery and interpretation of the CBR is worth considering as an example of the curious paths progress in science can take.

Lemaître was the first to speculate on the physics and possible observable remnants of the very early stages of expansion of the universe. He imagined

Who Knew?

COSMOLOGY

The Multiverse

The universe as we know it just got more complicated

The universe is bigger than we think. This seems to be a cosmic truth. Times change, theories evolve, astronomers see new things in their telescopes—and the universe always turns out to be vaster and more mind-boggling than anyone suspected. The most dazzling new theory holds that our universe isn't just big, it's one of many. It's like a bubble in a huge vat of beer, and every other bubble is another universe. (We like this image for some reason.)

Our concept of the universe used to be tidier. Ancient Egyptians thought the sky was held up by mountains at the corners of the Earth, and the stars were not so far away. But in the 17th century the telescope shattered that notion. Through the lens, the stars were countless, and space had depth. Stars were suns, rendered faint only by great distance. Then, in 1923, Edwin Hubble proved that mysterious, wispy things called nebulae are actually galaxies, or "island universes," outside our own.

New telescopes have since revealed ever more galaxies, and we've grown accustomed to living in Carl Sagan's cosmos, with *billions and billions* of galaxies, each utterly lousy with stars. But Sagan may have been underestimating.

A satellite called the Wilkinson Microwave Anisotropy Probe recently captured a glimpse of the residual radiation from the young universe, when there were no galaxies, only perturbations in a seething, expanding cosmos. The data give a precise age to the universe: 13.7 billion years, plus or minus 200 million years. Perhaps more significantly, the data support the idea of cosmic inflation, a variant of the big bang. The inflationary theory states that very early in the expansion the cosmos suddenly inflated, becoming unimaginably vast in a fraction of a second.

If inflation is correct, the universe really is more than a million trillion trillion trillion times larger than the already enormous visible cosmos. It's practically infinite in scale. You have to speak like a child to convey the idea—it's basically a gazillion times larger than we thought. And there's more: One variation of the inflation theory suggests that our universe is a calm bubble, a kind of "no inflation zone" within an infinitely large, chaotic, eternally inflating "multiverse," and that this multiverse contains countless bubble universes, some of which almost surely contain intelligent observers trying to make sense of their own crazy cosmos.

The problem is, a multiverse is a hard theory to prove. "Is this science? Not yet," warns cosmologist Michael Turner of the University of Chicago. "We can't test it."

But here's the most alarming part about living in a multiverse. If the cosmos is more or less infinite in scale, then statistical probabilities dictate that somewhere there's a planet identical to Earth, containing creatures identical to us, leading identical lives.

We don't buy it. Could there really be another world where Adam Sandler is a movie star?

—*Joel Achenbach*
WASHINGTON POST STAFF WRITER

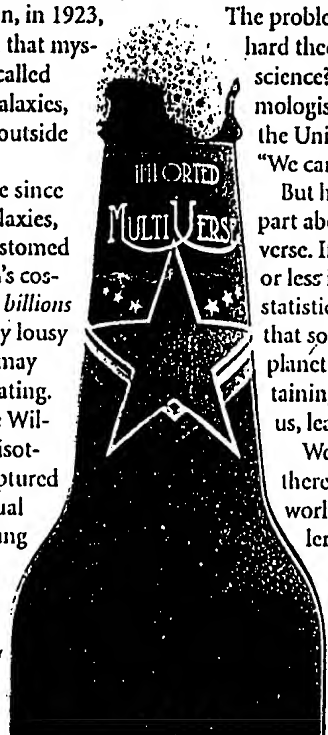

PHOTO ILLUSTRATION BY CARY WOLINSKY

IT MATTERS

How far apart are those two planets? Scientists measure length in meters. Kilometers and centimeters are just multiples and fractions (respectively) of the basic unit. But exactly how long *is* a meter? Since 1983 the International Bureau of Weights and Measures in Sèvres, France (keepers by treaty of the world's standard units of measurement), has decreed that a meter is precisely the distance light travels through a vacuum in 1/299,792,458 of a second. (How do you measure a hundred-millionth of a second? Don't ask.) That degree of precision matters. If astronomers measured a meter the way most Americans do ("Y'know, about a yard") imprecision would multiply prodigiously. Just between Earth and Mars you'd get a measurement mistake four million miles long.

—*Lynne Warren*

WEBSITE EXCLUSIVE

Learn more about the shape of the cosmos and find links to Joel Achenbach's work at nationalgeographic.com/ngm/resources/0308.

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37 CFR 1.312 AMENDMENTS

In handling 37 CFR 1.312 amendments, the examining corps should process drawings canceled in the normal manner. If there are corrections to the drawing, approval, if appropriate, is indicated by the examiner on form PTOL-271 in conjunction with form paragraph 6.48; the paragraph sets the appropriate period for effecting the approved drawing change.

¶ 6.48 Drawing Changes in 37 CFR 1.312 Amendment

Applicant is hereby given ONE MONTH from the mailing date of this letter or until the expiration of the period set in the "Notice of Allowance" (PTOL-85) or "Notice of Allowability" (PTOL-37 or PTO-37), whichever is longer, to file corrected drawings.

Examiner Note:

Use with the 37 CFR 1.312 amendment notice where there is a drawing correction proposal or request.

608.03 Models, Exhibits, Specimens

35 U.S.C. 114. Models, specimens.

The Director may require the applicant to furnish a model of convenient size to exhibit advantageously the several parts of his invention.

When the invention relates to a composition of matter, the Director may require the applicant to furnish specimens or ingredients for the purpose of inspection or experiment.

37 CFR 1.91. Models or exhibits not generally admitted as part of application or patent.

(a) A model r exhibit will not be admitted as part of the record of an application unless it:

(1) Substantially conforms t the requirements of § 1.52 or § 1.84;

(2) Is specifically required by the Office; or

(3) Is filed with a petition under this section including:

(i) The fee set forth in § 1.17(h); and

(ii) An explanation of why entry of the model or exhibit in the file record is necessary to demonstrate patentability.

(b) Notwithstanding the provisions of paragraph (a) of this section, a model, working model, or other physical exhibit may be required by the Office if deemed necessary for any purpose in examination of the application.

Models or exhibits are generally not admitted as part of an application or patent unless the requirements of 37 CFR 1.91 are satisfied.

With the exception of cases involving perpetual motion, a model is not ordinarily required by the Office to demonstrate the operativeness of a device. If operativeness of a device is questioned, the applicant must establish it to the satisfaction of the examiner, but he or she may choose his or her own way of so doing.

A physical exhibit, not to be part of the application, is generally not refused except when bulky or dangerous. Such exhibit, if left with the examiner, may be disposed of at the discretion of the Office.

37 CFR 1.93. Specimens.

When the invention relates to a composition of matter, the applicant may be required to furnish specimens of the composition, or of its ingredients or intermediates, for the purpose of inspection or experiment.

See MPEP Chapter 2400 regarding treatment of biotechnology deposits.

608.03(a) Handling of Models, Exhibits, and Specimens

All models and exhibits received in the U.S. Patent and Trademark Office should be taken to the Technology Center (TC) assigned the related application for examination. The receipt of all models and exhibits which are to be entered into the application file record must be properly recorded on the "Contents" portion of the application file wrapper.

A label indicating the application number, filing date, and attorney's name and address should be attached to the model or exhibit so that it is clearly identified and easily returned after prosecution of the application is closed, if return is requested and the model or exhibit is deemed not necessary for the examination of the application. See 37 CFR 1.94.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: DONALD GILBERT CARPENTER **Art Unit:** 2834

Serial No.: 09/935,936

Filed: August 23, 2001

For: Energy Conversion Technique **Examiner:** Nicolas Ponomarenko

O I P E JC22 JAN 07 2004 PATENT & TRADEMARK OFFICE

Declaration Under 37 C.F.R. ¶ 132

I, the undersigned Dr. Donald G. Carpenter, residing at 3010 River Mist Grove, Colorado Springs, CO 80922-5201 declare as follows:

I am a retired Air Force Colonel, pilot and Commander who has strong credentials and success in both academic and industrial careers.

Academically, I have a Ph.D. and a master's degree in nuclear engineering, plus bachelor degrees in physics, electrical engineering, and electronic engineering technology. I taught physics for seven years at the United States Air Force Academy, holding during that time an Associate Professorship. I created the space physics course at the Air Force Academy, editing and writing much of the 700+ page textbook for that course. I retired as a full Professor of physics (Chapman College) and full Professor of electrical engineering (Colorado Technical University), and Dean of electrical engineering and computer engineering (Colorado Technical University).

My published works include 27 scientific papers and books. Other scientific efforts include numerous published letters, abstracts and invited talks. I was, while on active duty in the Air Force, a recipient of the Theodore von Karman Award (for science and engineering) for dramatic improvement in the accuracy of the SPACETRACK System for tracking Earth-orbiting satellites.

Also, while on active Air Force duty, I received the Legion of Merit for management of the 16th Surveillance Squadron (a SPACETRACK radar organization in the Aleutian Islands). I subsequently commanded a worldwide AF operations organization. My last active duty position before retiring from the Air Force was Chief of Space Surveillance. I was, moreover, in charge of systems engineering (electronic) for Contel's contract to provide ground/space telecommunications at Falcon Air Base (Space Command); and was a principal engineer in enabling Falcon to function well.

Following my retirement from active Air Force duty I worked for COLSA as a telecommunications consultant to the Royal Saudi Air Defense Forces.

Among my further technical and scientific achievements, I was the first scientist to warn and prove theoretically (*Journal of Geophysics*) that nuclear reactors in orbit about Earth would

significantly increase the geomagnetically-trapped corpuscular radiation; subsequent Japanese experience with Russian Earth-orbiting reactors proved my analysis to be correct.

I also have held various other positions such as Senior Research Fellow for the International Society for Scientific Enquiry (ISPE).

Experimental Apparatus

The Experimental Apparatus equipment described herein is of minimum accuracy and precision, difficult to use, but quite inexpensive (see Figure 1). It is similar to that of a double pendulum. A wooden bar is supported at each end. Hanging by stranded picture wires from the wooden bar are two identical metal hex-head screws ([5/8]-11 4) so that, at the bottom of their respective swings, the heads of the screws engage endwise (and compress) a spring mounted between them. Each screw is suspended by two stranded wires, and each of those wires has one end attached to its own small hook screwed into one side of the wooden bar with the other end of the wire similarly attached to the other side of the wooden bar.

The screws are operated by swinging each of them back from the other, gaining potential energy as they necessarily rise to a pre-selected 'standard location'. They are released, allowing the potential energy to convert to kinetic energy as they return to their former lower positions and deposit the kinetic energy into the spring. The spring is made of 15 turns of number 19 steel wire coiled 33 millimeters long and of 11 millimeters outside diameter. Each screw head is larger than the diameter of the spring.

As shown in Figures 2 and 3, three paper cylinders are needed, with the first nested inside the second which is nested inside the third, so that each of the two nested cylinders slide relatively freely within the next larger cylinder. Their summed length needs to total greater than the length of the spring, each cylinder itself being less than 50% of the length of the spring (Figure 1). They are positioned in partially-nested fashion within the spring (Figure 3) so that their combined partially-nested length is the same as that of the 33 millimeter spring. Together, the spring and its enclosed partially-nested paper cylinders form an energy sensor. It is necessary that the paper cylinders have a small but non-zero amount of friction with respect to each other. Too little friction and the impact of the screw will cause the paper cylinders to over-respond; too much friction and the paper cylinders will not respond adequately. "Super Glue," a trademarked product is suitable for making the paper cylinders, but care must be taken to insure that the friction among the cylinders is adequate for the purpose of the experiment.

Experiment and Resultant Data

The experiment is tried three different times under each of three different conditions. The first condition is that the spring is suspended on thread below the wooden bar such that the screw heads will engage and compress it at their maximum speed (bottom of their paths). Before each trial, the partially-nested paper cylinders are placed within the spring so that one end of the largest cylinder is at one end of the spring and the contiguous opposite end of the smallest cylinder is at the other end of the spring. The length of the spring is recorded (x_0). Each screw is drawn back to its standard location, and they are released simultaneously. As the spring is struck on both ends approximately simultaneously and compressed, the total contiguous length of the

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partially-nested paper cylinders is reduced as shown in Figure 4. The new total length of the paper cylinders is measured after the system has settled down, and that length is recorded (x_1). The difference between it and the recorded, uncompressed spring length yields a measure ($x_0-x_1=\Delta x_1$) of the amount the spring was compressed. After this has been done three times, the results are averaged, and the average value (Δx_{1A}) is recorded to a precision of one millimeter for this first condition.

The second condition, illustrated in Figure 5, is that the spring is bonded (with Super Glue) by one end to the head of Screw 1 so that the free end of the spring rests loosely against the head of Screw 2. One end of the partially-nested cylinders is against the Screw 1 end of the spring while the other end of the partially-nested cylinders is at the other end of the now-cantilevered spring. Screw 1 is fixed in position so that it will not move when the spring is struck by the head of Screw 2. Screw 2 is withdrawn to its standard position and released. Again the resultant total length of the nested cylinders (x_2) is measured, and the magnitude of the spring compression found ($x_0-x_2=\Delta x_2$). After this has been done three times and the results averaged, the average value (Δx_{2A}) is recorded to a precision of one millimeter for this second condition.

The third condition, shown in Figure 6, is similar to the second condition in that one end of the spring is still bonded to Screw 1, and the free end of the spring rests loosely against the head of Screw 2. One end of the partially-nested cylinders remains at the other contiguous end of the cantilevered spring. Screw 1 and Screw 2 are each withdrawn to their standard locations and released simultaneously. Again the total length of the nested cylinders (x_2) is measured, and the magnitude of the spring compressed found ($x_0-x_3=\Delta x_3$). After this has been done three times and the results averaged, the average value (Δx_{3A}) is recorded to a precision of one millimeter for this third condition.

Theory

The spring and nested cylinders form an energy sensing device. When, as shown in Figure 5, a single moving screw and a single stationary screw compress the spring, the magnitude of the Force (F) exerted on the spring at each instant is $F=k(\Delta x)$, where k is the spring constant and (Δx) is the amount of compression. Force through differential distance ($d[\Delta x]$) is the differential Energy (dE) or work, which in integrated form for the second condition is $E_{2A}=(\Delta x_{2A})^2(k/2)$. The value of E_{2A} is the potential energy of a suspended single Screw before release from its standard location, and that same Screw's kinetic energy as it initially encounters the near end of the spring.

The value of E_{1A} is the average of the sum of the potential energies of the two Screws ($E_{1A}=2E_{2A}$) that is deposited into the spring. Note that this conforms to the law of conservation of energy, and should be equal to approximately two times the potential energy of one screw.

The value of E_{3A} (illustrated in Figure 6) is a bit more of a problem for both minor and major reasons. The spring and nested paper cylinders are now part of Screw 1. The law of conservation of energy says that, when viewed from the position of the experimenter, the energy measured must equal approximately the sum of the potential energies (E_{1A}) of the two screws at their standard locations, which is about two times the potential energy (E_{2A}) of one screw at its

standard position. The word approximately is used because the mass of Screw 1 now includes the mass of the spring and nested paper cylinders with glue. This, though, is a minor problem because the combined mass of the spring, nested paper cylinders, and dried glue is a very small fraction of the mass of a screw. The increase in energy expended is, thus, a minor fraction of the kinetic energy of one screw alone.

The major problem is that the energy measuring device is now part of Screw 1's system. It does not 'see' itself as moving but does see the Screw 2 system approaching a speed 2v. This view is part of the concept first enunciated by Jules Henri Poincaré*: the laws of physics are the same in every frame of reference that is moving linearly with respect to each other. This means that $E_{3A}=4E_{2A}=2E_{1A}$ instead of $E_{3A}=2E_{2A}=E_{1A}$, as anticipated by the law of conservation of energy. Thus, because $E_{3A}-2E_{2A}=2E_{2A}$, an extra $2E_{2A}$ becomes available that comes from some source, the nature of which is not at all clear at this writing.

Results

The experimental results are shown in Table 1. Due to the lack of precision with these present experimental components, all numbers are rounded to the nearest millimeter, or to the nearest whole number in the case of fractions.

TABLE 1: Experimental Results

Condition	Spring Length (mm)		Δx_{CA}	$(\Delta x_{CA})^2$	$E_{CA}=(\Delta x_{CA})^2(k/2)$	E_{CA}/E_{2A}
	Original	Compressed				
C=1 (Cons. Energy)	33	26	7	49	49(k/2)	2
C=2 Cantilevered, One Screw, Immobilized	33	28	5	25	25(k/2)	1
C=3 Cantilevered, Both Screws Moving	33	23	10	100	100(k/2)	4

Conclusions

With respect to condition 1, the laws of conservation of momentum and conservation of energy both pertain. Both conservation of momentum and conservation of energy also pertain in condition 2. For condition 3, the law of conservation of momentum pertains and the law of conservation of energy is believed to pertain, the 'extra' energy ($2E_{2A}$) that appears in condition 3 coming from some source not previously recognized in such cases.

It must be emphasized that the device described in the instant patent application is no more a 'perpetual motion' machine than is a hydroelectric transformer. We do not know for

certain at this time from where the extra energy comes for this simple experiment just as we also do not know why a wire moving at a right angle (relative to a magnetic field) through a magnetic field produces an electrical potential between the two ends of the wire. Thus, we do not know why a hydroelectric generator works.

Turning to the claimed invention, it matters not from whence this energy actually comes, it only matters that the claimed apparatus is a device that accesses this energy form without regard to the source of the energy.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date MARCH 4, 2003

Donald G. Carpenter

Reference

* H. Poincaré, 'L'etat Actuel et L'avenir de la Physique Mathematique' (The actual state and the path of mathematical physics) is the name of a lecture given at the St. Louis Conference, USA, 1904 September 24 (This information from the notes of Walter van der Kamp [died: 1998 January 26] was courteously supplied by C. van der Kamp 1998 August 25, Semi-private Communication).

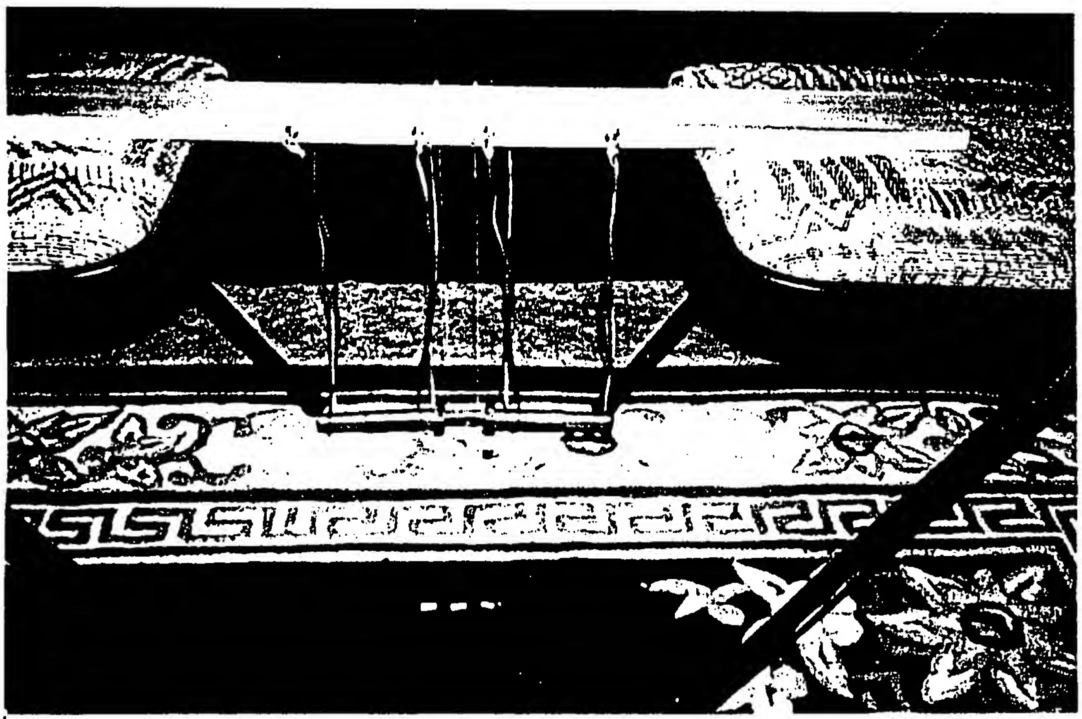

Figure 1

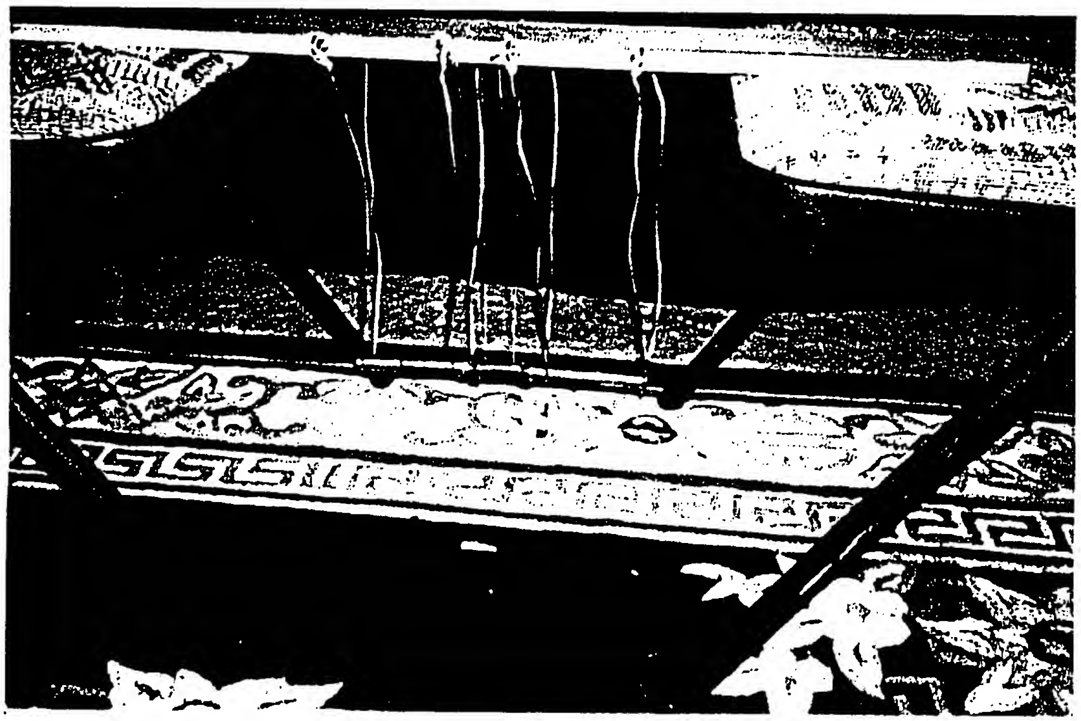

Figure 2

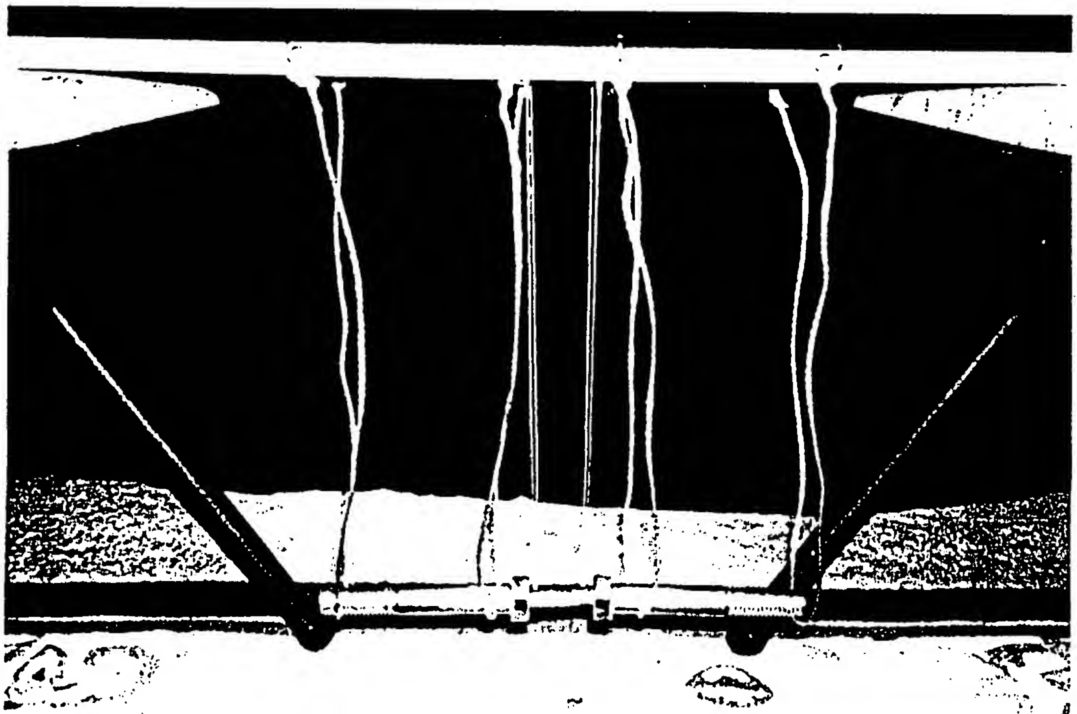

Figure 3

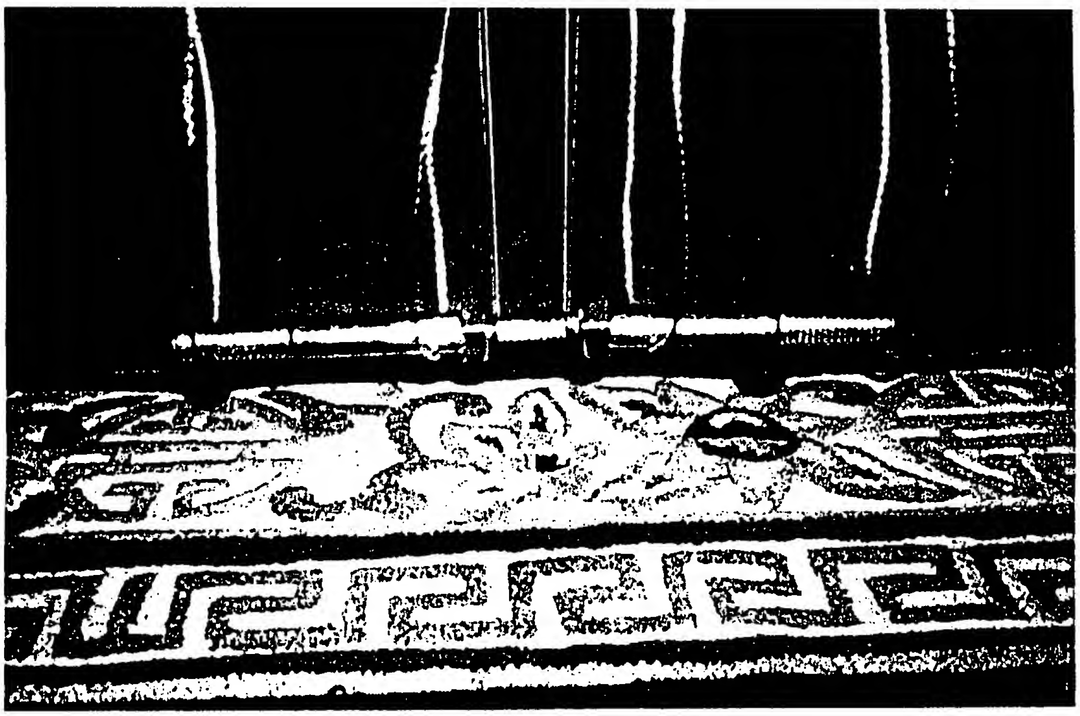

Figure 4

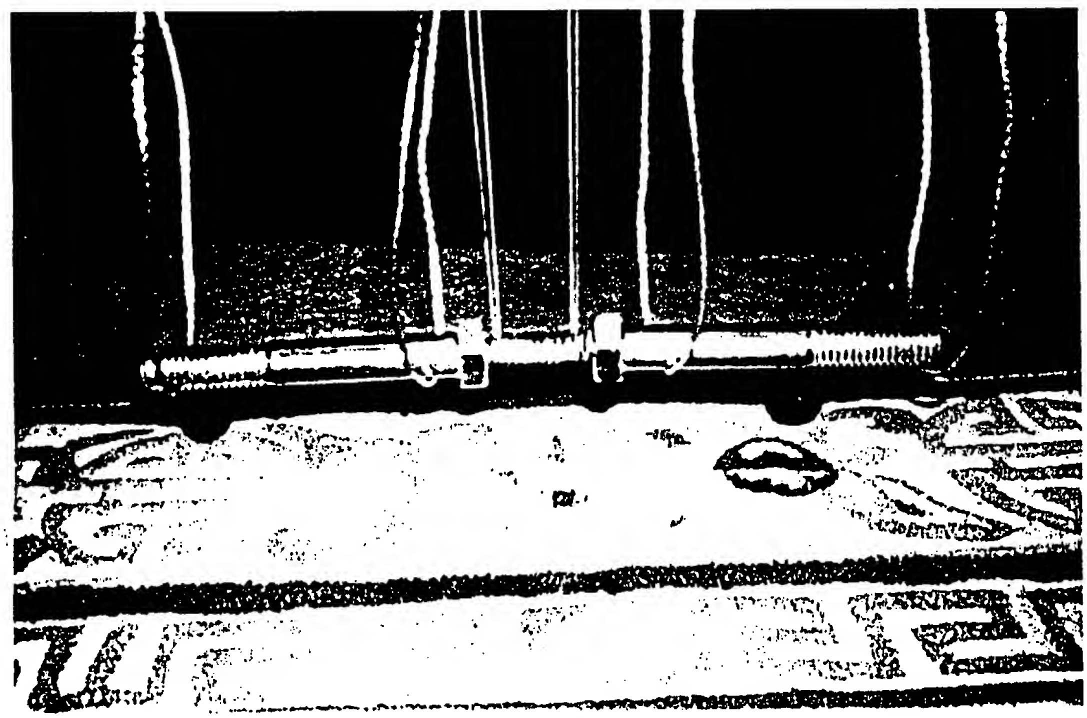

Figure 5

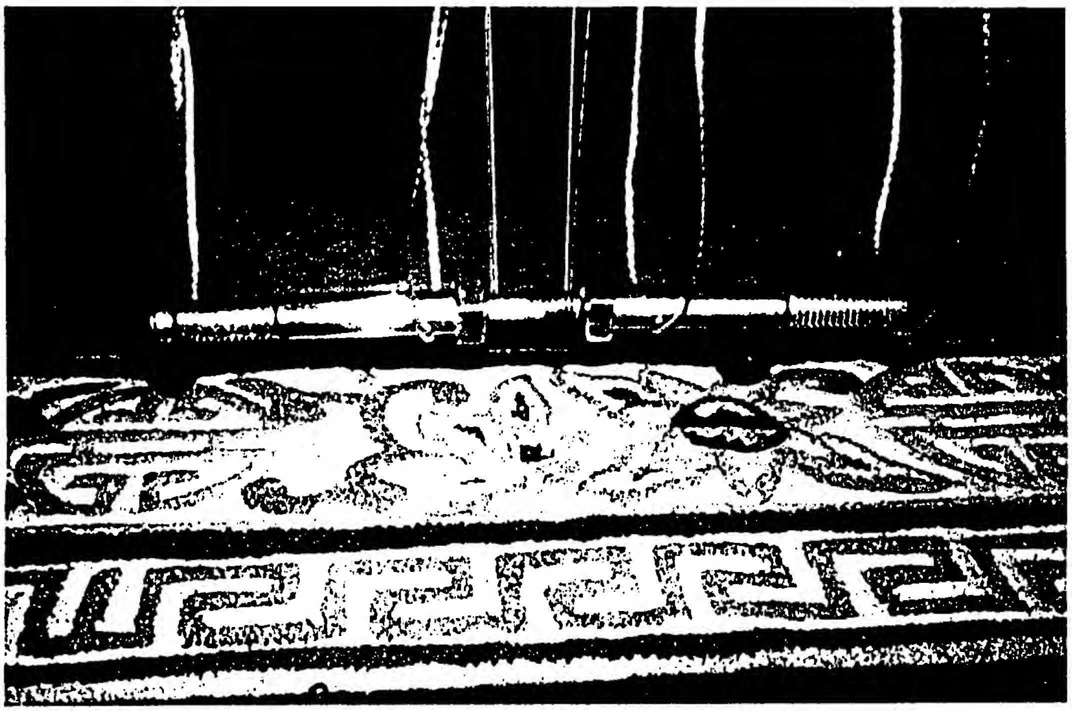

Figure 6

Claims on Appeal

What is claimed is:

1. A device for converting kinetic energy into electrical energy comprising, a first moving system, a second moving system for relative movement toward and away from said first moving system, an object for transfer between said first moving system and said second moving system for developing the kinetic energy relative thereto, means for converting the kinetic energy from said object at second moving system into electrical energy.

2. A device according to claim 1 further comprising discharge means for transferring said kinetic energy extracted object from said second moving system to said first moving system to develop the kinetic energy relative to said second moving system, and further kinetic energy extracting means for converting kinetic energy from said object at said first moving system into electrical energy.

3. A device according to claim 1 wherein said object is magnetizable.

4. A device according to claim 1 wherein said object is a rod for selective reciprocation between said first and second moving systems.

5. A device according to claim 3 wherein said means for converting the kinetic energy from said object into electrical energy has an electrically conductive coil.

6. A device according to claim 2 wherein said discharge means has an electrically conductive coil.

7. A device according to claim 1 wherein said first and second moving systems each have respective drive shafts coupled thereto, fly-wheels connected to said drive shafts and driven thereby, each of said fly-wheels having gear teeth, gears meshing with said fly-wheel gear teeth, driven by and driving said meshing gears for selectively producing electrical energy and kinetic energy.

8. A device according to claim 4 wherein said rod comprises a shaft having a transverse array of ridges formed along the length thereof, and an end to said shaft, a tube for said second moving system for selective mating with said shaft, said tube having openings formed therein, and gears protruding through said respective openings, said gears meshing with said ridges and being driven thereby as said shaft reciprocates between said first and second moving systems, motor generators coupled to said gears and being driven thereby to selectively produce electrical power and to drive said shaft.